SAF PROFESSIONAL READING LIST : COMMAND AND STAFF COURSE

500 Upper Jurong Road, #01-07 SINGAPORE 638364
Tel : 67997360, Fax : 67997364

INTRODUCTION

1.   Nurturing first class people in a world-class organisation is one of the key thrusts under the O.N.E. SAF framework. This would require us to strengthen our professionalism, create knowledge and build the necessary leadership competencies. One of the measures undertaken by SAFTI MI to strengthen the professionalism of our officer corps is to inculcate a spirit of life-long, self directed learning and a good reading habit which includes the promulgation of a SAF Professional Reading List (PRL) .

SAF PROFESSIONAL READING LIST: RATIONALE

2.   The SAF Professional Reading List (PRL) was devised to cultivate and stimulate the reading habit of SAF officers/learners attending the four ROA courses in SAFTI MI. This Reading List was also formulated to provide SAF officers/l earners some insights into the thinking and vision of our senior political and military leadership, past and present and to get them thinking and discussing military-related issues with the help of review questions.

SAF PROFESSIONAL READING LIST: COMMAND AND STAFF COURSE

3.   The SAF PRL consists of 4 segments with each segment comprising 5 to 6 short articles (speech, journal article, or book extract). For Command and Staff Course (CSC), the PRL theme is Warfare and Technology. By the time SAF officers attend Command and Staff Course, they would have some grounding in strategic and military studies as well as the subject of military technology. Hence, they would be able to appreciate the context in which technology can play an important role in war. A thoughtful study of the articles provided would enable officers at this stage of their career to better understand the contributions and limitations of technology in waging wars.

4.   The following articles comprise the CSC segment of the SAF PRL:

a. Tim Huxley, "Singapore and the Revolution in Military Affairs: An Outsider's Perspective" (see **ANNEX A**).

b. Lee Hsien Loong, "Science and Technology in National Defence" (see **ANNEX B**).

c. Lui Pao Chuen, "The Revolution in Military Affairs: Technological Solutions for Budget Tight and Manpower Scarce Armed Forces" (see **ANNEX C**).

d. Christopher M. Schnaubelt, "Whither the RMA?" (see **ANNEX D**).

e. Teo Chee Hean, "Trends in our Security Environment" (see **ANNEX E**).

5.   Two review questions for this theme are provided below to guide officers in their reading and to provide focus as follows:

a. What is the role played by technology in enhancing Singapore's security?

b. How effective is military technology for armed forces operating in today's complex and uncertain environment?

6.   We hope you have an insightful reading!

MILITARY STUDIES BRANCH
CENTRE FOR LEARNING AND MILITARY EDUCATION

Singapore And The Revolution In Military Affairs: An Outsider's Perspective

Dr Tim Huxley
Pointer V30N1 2004

Singapore's military capability is, by most measures, the most advanced in Southeast Asia. The build-up of Singapore's armed forces and its national defence industry, as well as local defence R&D, reflects the determination of the People's Action Party government to ensure the city-state's survival in a potentially hostile regional environment. Over the last decade, the key advantages of a highly-developed economy and a relatively highly-educated population, reinforced by increasingly intense interaction with the armed forces and defence industries of advanced industrial countries, have allowed Singapore to begin taking advantage of the opportunities offered by the contemporary Revolution in Military Affairs (RMA). The Singapore Armed Forces (SAF) has fielded increasingly sophisticated systems, particularly in the RMA-critical areas of precision weapons, command, control, communications and computer-processing (C4), and intelligence, surveillance and reconnaissance (ISR). Integrated logistic support (ILS) is also well-developed.

At the same time, several factors constrain Singapore's efforts to exploit the RMA more fully. Crucially, the vital doctrinal and organisation innovation required to maximise the benefits of the RMA is so far rather less well advanced. Secondly, Singapore's defence planners need to focus on adapting the RMA to the city-state's strategic circumstances, in terms of the need to respond to an expanding range of potential asymmetric threats as well as increasing military capabilities within the region. Thirdly, the modernisation of Singapore's military capabilities is taking place in circumstances of budgetary stringency, exacerbated by the financial implications of major procurement programmes aimed at enhancing conventional deterrence and war-fighting capability. However, the notion of military transformation, which is currently taking root in Singapore's defence establishment, offers a framework for mitigating these factors.

Singapore's Defence Posture

Geopolitical circumstances have forced Singapore's government to take defence extremely seriously since the city-state separated from Malaysia in 1965. Though the government sees security holistically and the strategy of Total Defence provides for the wholesale mobilisation of the population and national resources in time of crisis or conflict, the military component of defence has always loomed large. Despite Singapore's small size and population, by the late 1990s its armed forces were probably the best-equipped, best-trained and potentially most effective in South-

east Asia . The government routinely devotes 25-30% of its total annual spending (roughly 5% of GDP) to the armed forces. In 2003/4, Singapore's defence budget amounts to S$8.25b (US$4.7b), by far the largest national defence effort in Southeast Asia.[1]

In developing the city-state's armed forces, Singapore's leaders have increasingly stressed the importance of exploiting technology to compensate for the lack of strategic depth and shortage of professional military manpower. The SAF prizes its "technological edge" , which has almost certainly provided it with conventional military advantages over any likely adversaries in its immediate region. In part, this technological edge has derived from purchases of advanced military equipment from overseas suppliers (for example, F-16C/D fighter/strike aircraft from the US during the 1990s) but it is also a product of Singapore's own highly capable defence industry and substantial defence R&D efforts.

Clearly, Singapore's defence establishment recognises the RMA's significance. According to *Defending Singapore in the 21st Century (DS21)*, Ministry of Defence's (MINDEF) most recent comprehensive defence policy statement (issued in February 2000):

The revolution in military affairs will change the nature of warfare. Superior numbers in platforms…will become less of an advantage unless all these platforms can be integrated into a unified, flexible and effective fighting system using advanced information technologies. At the same time, the ever-increasing reliance on information technology means that protecting one's own information systems and disrupting the enemy's will become a major aspect of warfare…[2]

Placing the SAF's future development firmly in this new context, DS21 promised that the SAF would "exploit developments in the RMA, such as the integration of information technology into weapon systems" to achieve battlefield superiority.[3] As for Singapore's defence industry, "the digital battlefield of the future and the need for commercial technology in IT and communications will influence the approach we take to ensure that we sustain a technological edge."[4]

Organisational and Doctrinal Issues

In purely technological terms, Singapore is evidently acquiring many of the necessary pre-requisites for participation in the RMA. However, MINDEF and the SAF have not so far implemented the doctrinal and organisational innovations that are probably necessary to absorb these technologies into an effective "system of systems". While there are important indications that the SAF has begun laying the foundations for major doctrinal shifts and organisational restructuring, there is clearly still a long way to go.

Even before discussion of the RMA became voguish, the SAF 2000 planning blueprint adopted in 1988 as the result of a major force structure review brought significant changes to Singapore's military organisation and doctrine, particularly in the army. Under Army 2000, a single-service derivative of SAF 2000, army doctrine stressed offensive combined arms operations and the conduct of a "24-hour battle". In organisational terms, the most important change under Army 2000 was the introduction of genuine (as opposed to nominal) combined arms divisions, each including an armoured brigade as well as two infantry brigades, even in peacetime. Another innovation was the establishment of 21st Division, a light rapid deployment formation trained for air-mobile and amphibious operations. In the mid-1990s, the organisational evolution went a step further with the integration of reservist and active units within the three combined arms divisions.[5]

SAF 2000 also brought much greater emphasis on joint-service cooperation, and from 1994 established the Integrated Warfare concept as the basis for a doctrinal framework which attempted to integrate and exploit synergies in the three services' capabilities through a joint-service command and control system. Because of the SAF's relative youth as an organisation, small regular cadre and the lack of strong single-service traditions, institutional obstacles to joint operations are rather weaker than is the case in many longer-established national armed forces. As a result of this new emphasis on joint-service operations, in 1989 the air force established a Tactical Support Wing, which became Tactical Air Support Command (TASC) in 1991 with responsibility for planning, coordinating and providing air support for the army and navy. One key TASC activity is operating UAVs in support of the army. The increasing emphasis on joint-service cooperation was also clear in the establishment in 1995 of a tri-service officer training academy, the SAFTI Military Institute. In addition, the Tri-Service Staff Course, which is conducted six times a year for a total of up to 240 officers, is aimed specifically at furthering the SAF's Integrated Warfare capability.[6] Joint-service exercises have been held routinely since the 1990s.

MINDEF's commitment to exploiting new information and communications technologies to give the SAF a "strategic edge" in the area of C4 and ISR was clear even in the late 1980s and early 1990s.[7] In 1992, it was reported that the SAF planned operations based on a "radio electronic combat" doctrine that integrated electronic warfare with reconnaissance, physical disruption and deception.[8] However, this doctrinal emphasis increased greatly under Army 21, the planning blueprint which has guided the development of the SAF's land component since April 1999. Army 21 was written in the context of the RMA and emphasises the development of information capabilities, deriving from the "integration of command, control, communications and sensor systems", sufficient to achieve "dominant battlefield awareness".[9]

Senior MINDEF officials (from ministerial-level downwards) and many SAF officers speak the language of the RMA with a high degree of fluency, and evidently recognise the military component of a broader problem with which Singapore's leaders have been grappling since the 1990s: how to encourage Singaporeans to be more creative in order to retain and enhance the city-state's competitive advantages. A key problem in relation to the RMA is that Singapore's military command and control have in the past tended to be rigid and strictly hierarchical, with effective authority concentrated at the higher levels of MINDEF and the SAF. A reluctance to delegate authority to middle-level and junior commanders has been characteristic. For example, air force squadron commanders have reputedly hitherto been able to exercise little operational initiative compared with their Australian or British counterparts. The SAF's lack of organisational flexibility has been reinforced by not only the political and administrative system, which has tended not to reward individualism or creativity, but also by the local cultural milieu in which respect for elders and seniors, and considerations of "face", have traditionally been central features.

As in other areas of competition, it is evident that, in the field of defence, technological superiority alone is not sufficient for Singapore to come out on top. New information and communications technology has evidently stimulated much thinking within the SAF about the need for new command and control doctrines and new forms of military organisation. In 1999, the Singapore air force's Chief of Staff, Brigadier-General Rocky Lim, pointed out that, by providing rapid access to more information, the latest IT applications increase the pressure for decision-making at lower levels in the chain of command. According to Lim, this "could change your entire doctrine of air warfare".[10] The influence of intensified interaction with Western armed forces, which already practise more decentralised command and control, may also push MINDEF and the SAF to delegate operational authority to lower levels of command more effectively. This applies most obviously in case of the air force's long-term training programmes in the US, Australia and France, but elements of all three services train with Western forces that are themselves going through fundamental doctrinal and organisational change.

However, glimpses of internal debates within the armed forces, revealed in sources such as *POINTER*, suggest some impatience amongst younger middle-ranking officers for doctrinal and organisational change which would lend greater substance to Singapore's incipient RMA. As early as 1992, one young army officer (the commander of a Guards battalion) argued that the SAF could gain an edge over opponents by adopting the German military philosophy of *Auftragstaktik*, involving considerable decentralisation of command and control, and greater expectations of initiative on the part of lower-level commanders and even individual soldiers:

Our Asian heritage has unfortunately...put too much premium on the value of "face". We are exceedingly hierarchy-conscious to the extent that constructive criticism is extremely rare from bottom-up. It will take much time and deliberate effort to dispel the fear of ... subordinates to speak up if they think their superiors are in the wrong, and for the latter to accept constructive criticism.[11]

Writing almost a decade later, a more senior SAF staff officer returned to this theme, pointing to both the German army's *Auftragstaktik* and the Israeli army's similarly decentralised command system, both based heavily on the initiative of commanders and soldiers, as examples to be followed in implementing Army 21.[12]

More recently, several *POINTER* articles have argued for major organisational change within the SAF in response to technological developments. The essence of these arguments is that the SAF should adopt what one officer termed a "flatter and more network-based system".[13] More specifically, another officer has indicated that Army 21 may just "put new wine into old bottles", and argues in favour of "streamlined and flattened military organisations" which will "allow the SAF to compress the time needed for battle-procedure and decision-making" while at the same time reducing the vulnerability of the army to a pre-emptive enemy attack. Following the examples of the US Army's Force XXI and the French brigade-based army, he proposes that the Singapore army's basic combined arms units should be organised around brigades rather than divisions.[14]

Singapore's Strategic Future: How Relevant is the RMA?

Another key challenge for MINDEF and the SAF is to develop new doctrines and organisational forms that enable exploitation of advanced technologies in ways that are relevant to the city-state's evolving strategic predicament. Singapore's regional security environment has deteriorated significantly since the economic recession of 1997-98 and there are few signs that the city-state's strategic circumstances will improve significantly in the foreseeable future.

In these uncertain circumstances, Singapore's leaders — while never pointing at any specific threats — have repeatedly emphasised the continuing importance of the republic's military instrument for deterring conventional threats from other states. The ability of Singapore's defence establishment to continue developing and integrating operational concepts for the advanced information and communications technologies extensively employed for command and control, satellite and other surveillance systems (including airborne early warning, maritime patrol and tactical reconnaissance aircraft, UAVs, and ground-based radars), and precision-guided weapons — in other words, RMA-type capabilities — will be key to the SAF's continuing regional military superiority. The aim will be to allow the SAF (particularly the air force, navy and artillery) to locate, target and destroy targets

more effectively in the context of round-the-clock combined arms and joint-service operations. At the same time, greater emphasis on criteria of range and endurance in selecting major platforms (principally ships, submarines and aircraft) will provide Singapore with an artificial form of strategic depth by allowing the SAF to fight at greater distance from home.

However, like their counterparts in other states attempting to engage in the RMA, Singapore's security planners have needed to take into account possible asymmetric challenges to their probable conventional military superiority. Since the 1990s, social and political developments in Indonesia , in particular, have posed a new type of security concern for Singapore. Continuing social, economic and political instability, together with intensifying secessionist and inter-communal conflict around Indonesia's periphery, have raised the possibility of a "complex emergency" on Singapore's doorstep involving a breakdown in law and order, warlordism, communal conflict, piracy, hostage-taking, unregulated population movements, famine, rampant disease and environmental catastrophe. It is conceivable that the SAF could be drawn into diffuse, long-term low-intensity operations.

Other new challenges — from either governments or non-governmental groups — might include various combinations of bombings, the use of weapons of mass destruction (particularly chemical or biological agents) or information attacks, aimed at Singapore's civilian population and national infrastructure as well as military targets. Contamination of Singapore's water supply, for example, could be a particular effective asymmetric weapon. Though countering such asymmetric threats would largely be the responsibility of "Home Team" non-military agencies under the Ministry of Home Affairs (principally the police and civil defence force), the SAF has a range of capabilities relevant to such contingencies (for example, the army's Special Operations Force in the anti-terrorist role). According to Deputy Prime Minister and then-Minister for Defence Tony Tan, during 2000 — 2001 MINDEF and the SAF, working with the "Home Team", "made good progress" in developing "concepts, frameworks and operational plans" in relation to potential low-intensity conflict.[15]

The September 11 attacks in the US and the Singapore authorities' arrest in December 2001 of 15 members of *Jemaah Islamiah (JI)*, the Southeast Asian terrorist organisation allied with *Al-Qaeda*, in connection with a plot to attack local targets accentuated concerns over potential asymmetric threats. The main impact on Singapore's security and defence planning was to reinforce the validity of the long-established idea of Total Defence, which involves non-military agencies as well as MINDEF and the SAF in ensuring Singapore's security.[16] In November 2001, the government announced that it would implement a "homeland security" strategy involving closer cooperation between MINDEF and the home affairs ministry, and the SAF and police.[17] The JI attacks on Bali in October 2002 and on the Marriott hotel in Jakarta in August 2003 further exacerbated Singapore's acute concerns over

the threat from terrorism.

Particularly in light of recent regional developments, it is clear that Singapore's developing RMA-type capabilities do not provide a panacea for its widening security requirements. However, they are not necessarily irrelevant to emerging low-intensity security challenges. For example, the greatly-improved ISR capabilities likely to be generated by Singapore's investment in UAVs and satellites will be highly germane to the monitoring of population and shipping movements in the Malacca and Singapore Straits. Moreover, technological improvements in the capability of ordinary infantry soldiers, ranging from the SAR-21 rifle to the Advanced Combat Man System, have a wider utility than simply on a high-intensity battlefield against a conventional enemy. Information security systems may be as useful in protecting critical national infrastructure such as public utilities and air traffic control against "cyber-terrorism" as they are in defending military C4I systems against attacks by opposing armed forces.

Budgetary Constraints

A third major factor complicating the SAF's ability to benefit from the RMA is that Singapore's resources for military procurement and R&D are slim, particularly when compared with those available to the major Western military powers. To put Singapore's military budget in perspective: in approximate terms it amounts to less than 2% of the United States' or 12% of Japan's military spending. The RMA offers huge improvements in capability, but at great cost: even the United States' close military allies in Europe , such as the United Kingdom (which spends more than seven times as much as Singapore on defence) themselves face considerable difficulties in keeping up with US technological advances and ensuring inter-operability. With the deceleration of Singapore's economic growth and the emergence of new demands imposed by counter-terrorism measures on the overall security budget, there is little prospect that defence budget can expand significantly in real terms as long as the government maintains military spending within the long-established self-imposed cap of 6% of GDP. Already, it appears that the current budget crunch has not only restricted spending on overseas exercises and other training activities, but has also forced the deferment of some major procurement projects. Senior defence officials have highlighted the potential impact on the SAF in the longer-term of the escalating cost of replacing existing equipment.[18] For MINDEF and the SAF, developing RMA-type capabilities in the prevailing tough budgetary environment is clearly a major challenge.

Transformation

At the beginning of the present decade, Singapore's defence establishment began considering broader issues related to the SAF's modernisation, and

participation in the RMA has subsequently been presented as one component of a thoroughgoing process of military transformation. Key senior MINDEF officials and SAF officers see such transformation as imperative if the SAF is to develop its operational flexibility in an "uncertain and complex security landscape" , make the most of a limited defence budget in the context of escalating equipment costs, compensate for a demographic shift that will reduce personnel strength, and exploit the RMA as fully as possible - thereby maintaining its capacity to deter and defend against both conventional and unconventional threats.[19]

Writing in a recent issue of *POINTER*, Andrew Tan, formerly Director (Policy) in MINDEF, assessed the implications of transformation for the SAF. While Tan's comments were general rather than specific, they do provide some insight into the way that the SAF may develop in the future. Importantly, he argues that change in the SAF will involve "a series of adaptations to an evolving security environment" — in other words, more of an evolutionary than a revolutionary transformation. While maintaining its capacity to deter conventional attacks, the SAF will need to "move away from core competencies based on any form of numerical advantage" towards developing a "portfolio of capabilities" in which it maintains a "qualitative edge" that will provide Singapore's political leadership with a range of options in coping with an increasingly diverse threat spectrum.[20]

A significant indication of the potential for radical change in Singapore's military thinking and organisation came in early 2003 when MINDEF and the SAF established the Future Systems Directorate (FSD). FSD, which is commanded by a one-star officer known as the "Future Systems Architect" and has been allocated responsibility for managing 1% of the defence budget (approximately S$83m in 2003 -2004), is charged with challenging established military thinking to enable the SAF to cope effectively with the rapidly changing and unpredictable strategic environment. The Directorate is complemented by the SAF's Centre for Military Experimentation (SCME), which will use sophisticated simulations in its "battle labs" to "develop and evaluate new war-fighting concepts by creating an environment for exploration, experimentation and demonstration".[21] CME's emphasis, at least initially, is on exploiting C4I systems more extensively as force multipliers.

Two monographs published during 2003 under the auspices of *POINTER* underline the extent of officially-encouraged new thinking within MINDEF and the SAF and indicate ways in which Singapore's defence sector could change as a consequence of the transformation initiative now under way. Building on recent debates in *POINTER* over how the SAF might become a more effective "learning organisation",[22] the first monograph — *Creating the Capacity to Change: Defence Entrepreneurship for the 21st Century* — argues for a major cultural change that will create "C2C [capacity to change] space" alongside existing organisational structures in the sector. The intention would be to encourage "defence entrepreneurship" in

order to facilitate "constant change and innovation" in strategy, capability and warfighting. In the area of strategy, suggested "first steps" include building links with experts in critical national infrastructure, creating a new MINDEF/SAF forum and introducing relatively short-lived project offices to produce scoping studies of potential military innovations, and measures to nurture alternative viewpoints within the system. In the capability sphere, the monograph argues for "a capability innovation eco-system" which generates multiple, competing ideas. At the warfighting level, suggestions include setting aside "existing norms and practices" to establish new commands and formations, using modular forces which can quickly be reconfigured for new tasks, and developing wider intelligence networks.[23] The second monograph presents the case for the Integrated Knowledge-based Command and Control (IKC2) doctrine — intended to allow the streamlining and sharing of C2 resources throughout the SAF — as a central element of transformation efforts.[24]

In the medium-term future (perhaps by the year 2010), this radical thinking about the SAF's structure, equipment, and training, combined with the force multiplication effect of new C4I systems, implies that the SAF may evolve substantially. There will, of course, be considerable continuity in some areas of defence policy: for example, conscripts and reservists will continue to provide the great bulk of the SAF's manpower. However, large formations (most obviously the army's divisions, or at least some of them) may well disappear, while smaller formations could be better-equipped and more powerful. There are likely to be more specialist formations such as the Chemical, Biological, Radiological and Explosives Defence Group, established several years ago. At the same time, there is likely to be even closer cooperation between MINDEF and the SAF on the one hand, and non-military security agencies on the other.

Major items of older equipment are unlikely to be replaced one-for-one, as much more capable weapons systems extensively networked with ISR assets, are procured (or in some cases developed locally). For example, a single squadron of highly-capable fourth-generation Next Fighter Replacement (NFR) combat aircraft, due for selection in early 2005, might be judged sufficient to replace three squadrons of F-5Ss and A-4SUs. At the same time, new systems not previously fielded by the SAF may substantially increase its firepower: cruise missiles could provide a lethal and accurate but cost-effective option for long-range strike.[25] Remotely-controlled systems, such as naval UAVs or the LALEE airborne platform being considered as a successor for the RSAF's E-2Cs, may also play considerably more important roles in the future SAF. Overseas training will remain important, but may involve new locations that allow for exercises against less familiar adversary forces.

Conclusion

For little more than S$8b annually, MINDEF and the SAF provide Singapore with a remarkable range of military capabilities. In Singapore's immediate regional context, these capabilities presently outclass those of any potential opponent in conventional military terms. Singapore possesses highly educated and IT-literate military, research and industrial personnel, and its defence-industrial and R&D establishment has set up an extensive network of international links. For these reasons, it can almost certainly sustain its conventional military advantage for the rest of this decade. Not-withstanding bilateral and multi-lateral confidence-building efforts, however, in the longer-term Singapore is likely to face growing challenges from the modernised and expanded military capabilities of other regional states. In these circumstances, the city-state will need to develop smarter, more hard-hitting military capabilities to stay ahead of the game and maintain the SAF's deterrent and defensive capacity.

So far, the need for greater doctrinal and organisational innovation, the requirement to develop and adapt new technologies and military thinking in response to emerging unconventional challenges (such as terrorism and complex emergencies) as well as conventional threats, and budgetary constraints have prevented Singapore from leveraging the information-led RMA to maximum benefit. However, these factors have encouraged MINDEF and the SAF to mobilise the defence community's collective imagination to consider how to transform Singapore's military doctrine, organisation and capabilities in a more profound manner than simply by importing elements of RMA technology and thinking from overseas. Effectively, transformation will provide a context for adapting the RMA to Singapore's particular national requirements. Though the impact of this transformation is likely to prove evolutionary rather than revolutionary, its impact in the medium- to long-term will probably be far-reaching, ensuring that the republic's military capability is as well-adapted to new challenges as the budgetary and demographic constraints allow.

Endnotes:

1. "Budget 2001", *The Straits Times*, 23 Feb 2001.

2. *Defending Singapore in the 21ˢᵗ Century* (Singapore: Ministry of Defence, 2000), p10.

3. Ibid., p75.

4. Ibid., p69.

5. For details see Tim Huxley, *Defending the Lion City: The Armed Forces of*

Singapore (St Leonards, NSW, Australia: Allen & Unwin, 2000), pp123-6.

6. "Officers from the army, navy and air force to train together", *The Straits Times*, 7 Oct 1998.

7. "Information Technology: Giving the SAF a Strategic Edge", *Pioneer* (Mar 1990), pp14-17.

8. Prasun K. Sengupta, "Singapore and the Army 2000 plan", *Military Technology,* 7/1992, p73.

9. "Building the 21st Century Warrior - Army 21", *Pioneer* (May 1999), p13; *Defending Singapore in the 21 st Century,* p30.

10. "Millennium force", *Flight International* (16 Jun 1999), p67.
11. MAJ Peter Gwee Chon Lin, "Auftragstaktik. A Philosophy for Management, Training and War", *POINTER* Vol.18 No.4 (Oct-Dec 1992), p34.

12. LTC Tan Kim Seng, "Initiative as the Fighting Power in the Army 21's vision" [sic], *POINTER* Vol.27 No.3 (Jul-Sep 2001).

13. MAJ Seet Pi Shen, 'The Revolution in Military Affairs (RMA): Challenge to Existing Military Paradigms and its impact on the Singapore Armed Forces', *POINTER* Vol.27 No.2 (Apr-Jun 2001), p16.

14. CPT Fong Kum Kuen, "A Quantum Leap towards Knowledge Warfare: Revolution in Military Organizations in the SAF', *POINTER* Vol.27 No.2 (Apr-Jun 2001), pp80, 92, 94.

15. Statement by Dr Tony Tan at the Committee of Supply debate, 8 March 2001, Singapore Government Press Release, 8 March 2001.

16. "Sept 11 proves need for Total Defence, says DPM Tan", *The Straits Times*, 27 Oct 2001.

17. Lydia Lim, "S'pore to have 'homeland security'", *The Straits Times,* 5 Nov 2001.

18. Chief Defence Scientist, Professor Lui Pao Chuen, "Weapons of the Future: Let's think out of the box", *The Straits Times*, 12 Jul 2003.

19. BG Jimmy Khoo, "Eight Big Reasons why Transformation is not for the SAF", *POINTER* Vol.29 No.3 (Jul-Sep 2003), pp6-15.

20. Andrew Tan, "Military Transformation in a Changing Security Landscape: Implications for the SAF", *POINTER* Vol.29 No.3 (Jul-Sep 2003), pp30-33.

21. David Boey, "Battle lab to help reshape SAF war muscles", *The Straits Times* (12 Jul 2003).

22. LTA Benjamin Cher Tau Wei, "A Learning Army — Translating Theory into Practice", *POINTER*, Vol.29 No.1 (Jan-Mar 2003).

23. Choy Dawen *et al, Creating the Capacity to Change: Defence Entrepreneurship for the 21ˢᵗ Century. POINTER* Monograph No. 1 (Singapore: *POINTER*: Journal of the Singapore Armed Forces, 2003), pp39-50.
24. Jacqueline Lee *et al, Realising Integrated Knowledge-based Command and Control. Transforming the SAF, POINTER* Monograph No. 2 (Singapore: *POINTER*: Journal of the Singapore Armed Forces, 2003), p9.

25. See "Weapons of the Future: Let 's think out of the box", *The Straits Times* (12 Jul 2003).

Speech by Col Lee Hsien Loong on Science and Technology in National Defence at the Opening of the Science Seminar for Secondary Schools, Khatib Camp, 4-7 June 1984.

Throughout history, warfare has been a major impetus to the development of science and technology. The needs of national defence have always driven men to look for ways to protect themselves and vanquish their enemies using the resources of science, rather than of brute force and individual mortal combat. An early example is given by the efforts of Archimedes in the battle to defend Syracuse from the Romans. According to one account, he invented a super catapult which launched quarter ton stones at the enemy troops, and built crane-like beaks and iron claws which reached for and smashed the enemy fleet. Unfortunately the Romans eventually won, and Archimedes was killed. In our time, micro electronics, satellite technology and nuclear power, to name just three examples out of thousands, all were first conceived as new solutions to military problems.

In planning the defence of our nation, we therefore ignore science and technology at our peril. But developing and producing a weapon is no longer simply a matter of implementing the idea of a single genius like Archimedes. For all but the simplest items like rifles and mortars, it is the cooperative effort of teams of dozens of engineers, backed up by an even larger number of technicians, having access to sophisticated laboratory facilities, unlimited budgets, and an industrial base able to turn designs into devices. The design of each weapon system represents 500 to 1,000 man years of effort. Organisations which do this, such as Hughes Aircraft Company in the US, or Rafael in Israel, employ typically 1,000 engineers, working on related projects to generate a critical mass. For such a development effort to be economically viable, the product must be sold in large numbers, otherwise the overhead of R & D cost per weapon becomes exorbitant.

Take for example the Maverick missile, produced by Hughes Aircraft Company. This is a TV guided weapon launched from fighter aircraft, which homes automatically onto a target such as a tank or a ship, centred on the cross-hairs of the TV camera. It took Hughes five years, from 1964 to 1969, to develop the weapon to the point of firing the first prototype, and three more years before the first operational evaluation firing in 1972, under realistic and non-ideal conditions. Since then, Hughes has sold 26,000 Mavericks at S$150,000 a piece — cheap as modern guided weapons go. 1,200 Mavericks have been fired, 85% achieving direct hits. Successive versions of the Maverick have incorporated improvements made as a result of these test firings, as well as new technology such as an infra-red seeker, able to see through smoke and haze in place of the TV camera. The Maverick therefore represents a huge investment of effort and a vast accumulation of knowledge and experience.

From the point of view of a small country like Singapore, it is therefore far better to purchase Mavericks than to develop our own. What then are the specific aspects of defence technology we should focus on? To introduce a n e w weapon system into the SAF, such as the Maverick, we have to define rigorously what it is we need, evaluate it to see if it meets these needs, integrate it with our other weapons to make sure they complement one another, modify it as our needs change with time, and exploit it to its fullest potential when it is employed in battle. There are not trivial tasks, and they are tasks which we, our scientists and engineers, must do ourselves.

How would we know that the Maverick is the weapon we want? If we are ignorant and gullible, we will soon be parted from our money, because for every weapon we need and want, there are a dozen others which we do not need, but we may be persuaded to covet. We have to understand clearly what specific effect we want to achieve on the battlefield, under what conditions we want to use the weapon. Can the weapon do this? We must understand the technology. Does the weapon work? How does it work? Are there any other designs which are better? There is a Latin phrase caveat emptor — let the buyer beware. We must be smart buyers.

Assuming that we have decided to buy a new weapon, how can it be integrated with our other equipment? Fighter aircraft cannot simply carry Mavericks the way soldiers can carry new rifles — they must be modified. We must know enough to do this modification. It is as if we were buying a jigsaw puzzle one piece at a time, except that we are not sure what the new piece should look like, we may have to shave the old pieces a little so that the new one will fit, and sometimes we must dismantle an already assembled part of the picture, to make room for a particularly pretty new piece we have just bought. If we asked the jigsaw puzzle shopkeeper what to do, he might tell you that your half completed puzzle is no good, then you have done it all wrong, and you should throw everything away in order to buy his shiny new set, which just came in yesterday. So we have to become our own jigsaw puzzle expert.

For in-service weapons, as we build up our experience with them, we will want to modify them to perform better and to suit new and unforeseen requirements. These are not only technical problems, but depend also on how the weapons are being used. Such questions are examined in Operations Research, and the answers are often far from obvious. To take a small example, in the Second World War, British scientists examined the problem of protecting RAF bombers from anti-aircraft guns. They could armour plate the aircraft body, but they could not cover the entire aircraft, which would otherwise become too heavy to fly. The question was which parts to cover. 7 scientists examined the aircraft which returned from missions, and count the number of bullet holes on each part of the fuselage. Then they armour plated the parts which had no holes. Aircraft hit in these vital areas had not survived to be counted. This is the degree of understanding which our defence scientists must strive to attain.

In Operations Research, more than in any other field of defence science, a single penetrating insight can make all the difference between success and failure.

Exploiting our weapons also calls for close collaboration between the users and the scientists. Sophisticated weapons are expensive. Intelligently used, they can be devastating. Fired indiscriminately, at best they are a waste of money, at worst they may even be counterproductive. To develop effective tactics calls for intimate knowledge of the technical characteristics of the weapons. This is especially the case in the arcane field of electronics warfare, where the equipment only gives us the means of blinding, jamming, or deceiving the enemy, but how we actually do it depends on our ingenuity, and on our knowledge of the weaknesses of the enemy's systems. Smart weapons are not designed for dumb soldiers.

I have tried to explain why MINDEF places so much emphasis on defence technology. The purpose of this seminar is not to lecture you systematically on the whole field, but to stimulate your interest in a fascinating and important subject. I hope that you will enjoy doing the projects you have been assigned, and that you will begin to understand how science and technology can contribute to national defence.

The Revolution in Military Affairs: Technological Solutions for Budget-Tight and Manpower-Scarce Armed Forces

POINTER V25N3 1999
This article was adapted from a lecture given by Professor Lui Pao Chuen on 13 May 1998 at the Singapore Command & Staff College.

Events in the last 30 years that has shaped Military Developments.

Vietnam War and the US

In the 1960s, the two super powers, USA and USSR were locked in combat through their proxies in all the continents to defend and advance their respective political ideology. The success of Communism in Vietnam was viewed by the United States as the fall of the first domino with the rest of Southeast Asia going Red soon after. Hence the need to draw a line in the sand and throw in the entire might of the US military to prop-up the South Vietnamese Government. President Lyndon Johnson, escalated the war soon after he took office in 1963, after the assassination of President Kennedy. President Nixon who was elected in 1968 soon realized that the war in Vietnam could not be won and began peace negotiations. US troops were withdrawn in 1973. South Vietnam fell two years later in 1975. The US military was completely demoralised by their defeat in Vietnam. They had the most advanced weapons in the world. The world's first precision-guided munitions (PGMs) were used to bring down bridges to cut the Lines of Communication of North Vietnam. Helicopters became the work horse of the Army with a quantum jump of improvement in troop mobility. Airborne jammers and anti radiation missiles were fielded in the dedicated Wild Weasel Phantom jets to suppress the Russian made SA2 SAMs that North Vietnam had deployed to protect Hanoi and Haiphong. Agent Orange was used to defoliate jungles that gave cover to the Viet Congs. With the exception of nuclear weapons, nearly all the high-tech weapons in the arsenal of the US military were used in the Vietnam War. But, high-tech weapons were not enough, they had to deploy a large number of soldiers to secure the ground. To meet this need, they had to use the draft. Thousands of poorly trained and poorly motivated soldiers were sent to fight against an enemy that had been battle hardened since the 1950s against the French. To make things worse, college students were exempted from the draft creating resentment among the poorer educated youths. The war was also fought in US between the government and the public who opposed the war. Many lessons were drawn from the Vietnam War, of which I would like to mention only two. First, high-tech weapons cannot compensate for the lack of fighting spirit. Second, a war can be lost if the people back home do not support it. Hence, the vital need for winning the hearts and minds of the nation to support a war. The leadership of the US

military began to re-construct their forces after the Vietnam War, scarred by the memories of what had gone terribly wrong there.

The Afghan War and the USSR

With the end of the Vietnam War and the election of Jimmy Carter as President in 1976, the US was pre-occupied with domestic issues of economic recession and inflation. There were few foreign policy initiatives with the most memorable being the signing of a peace treaty between Egypt and Israel in 1979 and the recognition of PRC in 1978. Carter sought to improve the relationship with USSR through various initiatives under detente. This encouraged Leonid Brezhnev to believe that the US had gone soft on Communism and took this window of opportunity to invade Afghanistan in 1979, to settle a potential threat to USSR's southern flank.

Though the USSR did not have to deal with the same degree of public resistance to the war in Afghanistan like the US during the Vietnam War, they faced the same problem of using poorly motivated and poorly trained conscripts. They too learnt the lesson that high-tech weapons were not sufficient to defeat battle-hardened and committed guerrillas.

With the end of the Afghan War, there can be no more doubt in the military that the fighting spirit is the main ingredient for victory. The lack of the fighting spirit cannot be compensated by the deployment of high-tech weapons.

Soviet Empire: The Beginning of the End

Meanwhile through the 1970s, the Soviet economic performance gradually worsened and widespread corruption and inefficiency were evident. A major change in leadership took place in 1982 with the death of Leonid Brezhnev, after an 18-year reign as the General Secretary of the Communist Party of the Soviet Union (CPSU). Yurii Andropov, who succeeded him, died two years later without doing anything memorable. The next General Secretary, Konstantin Chernoko, lasted one year before dying in March 1985. The lack of suitable successors created the way for Mikhail Gorbachev, who was then the youngest member of the Politburo, to take over the Communist Party.

He began a policy of *Glasnost* (openness) which provided a greater degree of freedom for politics. It also allowed the development of nationalism in Russia and the other states of the Soviet Union. In June 1988, Gorbachev announced the introduction of a two-tier legislature, elected by open elections at the first Extraordinary Party Conference since 1941. In the election to the new USSR Congress of People's Deputies, in March 1989 many reformist politicians, including Boris Yeltsin, were elected. In May 1989, the Congress elected Gorbachev Executive President of USSR.

The events in the Soviet Union are fascinating during this period of rapid changes after 18 years of Brezhnev's stifling rule.

Coming back to Afghanistan, Gorbachev concluded that the war could not be won and began negotiations for withdrawal soon after he assumed power. The Soviet troops began their withdrawal in 1988, after suffering a similar humiliation, as the American troops, by an enemy armed with low-tech weapons but filled with an indomitable spirit.

President Ronald Reagan: The Winning of the Cold War

President Reagan took a completely different tack from his predecessor, Jimmy Carter. Instead of detente he went into the offensive to confront the Soviet Union which he called the evil *empire*. He reasoned that as the Soviet Union could not be defeated with arms without the US also suffering unacceptable losses, he would defeat them economically instead. The deterioration of the Soviet economy was apparent. They could not match the US in spending more money to build up their ORBAT nor counter the US in their military interventions in Latin America, Africa and the Middle East.

The two major initiatives of President Reagan to which the Soviets had no answer were the 600-ship Navy and the Strategic Defense Initiative (SDI). The 600-ship Navy would give the US Navy the capability of conducting war right into the backyard of the Soviet Union, the Barents Sea.

The SDI would give CONUS (Continental United States) an umbrella against Soviet strategic ballistic missiles giving the US the advantage to strike without the fear of retaliation. This would put an end to the strategic balance achieved by the MAD (Mutually Assure Destruction) strategy which had been in place since 1950s.

As the Soviets could not afford to match the Americans in spending on their version of SDI they tried to use diplomacy to eliminate this destabilizing weapon system. It projected the image of the US as a warmonger, escalating the arms race and militarising space to the world to pressurise the US to negotiate the termination of SDI. Though Reagan announced that SDI was for peace and the US would be willing to share the research findings with the USSR, he refused to negotiate the termination of the project.

Soon after Gorbachev came into power, he met Reagan at Geneva in Nov 1985. Though they did not reach an agreement on major arms control issues, the meeting was a landmark to signal the return to a less confrontational relationship between the two countries.

Besides ramming up the build-up of military power with large spending, Reagan also demonstrated his fighting spirit in the use of military power. Examples were the military occupation of Grenada in November 1982, the shooting down of Libyan fighters in a naval exercise in the Gulf of Sirte in March 1986, and the clash with Iran in 1987 in the Gulf to protect of Kuwait's petroleum tankers.

Gorbachev finally completed negotiations for the withdrawal of Soviet troops from Afghanistan in April 1988 and the agreement for the phase withdrawal of Soviet troops was signed by the USSR, the USA, Afghanistan and Pakistan. All Soviet troops pulled out of Afghanistan in February 1989.

Negotiation on arms control suffered a setback in October 1986 when Gorbachev failed to persuade Reagan to scale-down the US commitment to SDI in a 2-day meeting at Reykjavik, Iceland. A positive outcome of this meeting was the agreement to eliminate an entire class of ballistic missiles, the medium-range nuclear missiles from Europe by 1992.

In September 1987, the Intermediate Nuclear Forces (INF) treaty was signed by Gorbachev and Reagan. This treaty eliminated all stocks of medium-range and short-range nuclear missiles. The two leaders also agreed to pursue negotiations to reduce long-range nuclear weaponry by up to 50 percent under a new Strategic Arms Reduction Treaty (START).

In 1988, Bush was elected President succeeding Reagan. The first meeting between Gorbachev and Bush was in Dec 1989 at Valletta, Malta. They finalised the agreements on the monitoring of chemical weapons and the procedures for the verification of limits on strategic forces and nuclear tests.

The withdrawal by USSR in late 1989 and early 1990 from Eastern Europe opened the way for the reunification of Germany on 3 October 1990. This led to a further improvement in the US-Soviet relationship and US economic aid for East Europe.

A Treaty on Conventional Armed Forces in Europe (CFE) which provided for bilateral limits to be imposed on the number of non-nuclear weapons which would be allowed between the Atlantic Ocean and the Ural Mountains was also signed.

At the end of 1990, the Cold War was finally laid to rest with the USA, USSR and 32 other countries signing a charter, declaring the end of the post-war era of confrontation and division in Europe.

With the end of the Cold War, both USA and USSR were less constrained by problems close to their backyards. The US marched into Panama on 23 December

1989 to capture General Manuel Noriega, its leader, for trial in US for drug trafficking. The condemnation of the US Security Council of the invasion of Panama was ignored by the US.

On the hand, the US expressed dismay and displeasure with USSR for Gorbachev's heavy-handed treatment of independence movements in Estonia, Latvia and Lithuania which were considered part of the USSR.

The Peace Dividend — Not for the Military

Two issues of top priority for the newly-appointed Bush government were containing the ballooning Federal budget deficit and the arms reduction negotiation with the Soviet Union. A reduction in arms would relieve pressure on the Federal budget. The bills for weapons ordered during the Reagan administration would have to be paid.

The 1980 defence budget based on FY94 dollars was around US$250 billion. Reagan's arms race had rammed this level up by US$20 billion per year to reach a peak of US$370 billion in 1985 and remained at an average of $350 billion till 1991.

With the end of the Cold War, the defence budget was scaled down to below US$250 billion by 1994 and was to remain around that level in the foreseeable future. The impact on military spending was drastic. The estimated reduction in each category of spending between 1985 and 1994 was as follows:

Budget Categories	FY85	Reduction	Reduction	FY94
Military Personnel	$88B	-21.8%	$18B	$70B
Operation & Maintenance	$102B	-13.6%	$14B	$88B
Procurement	$129B	-64.1%	$83B	$46B
RDT & E	$45B	-7.1%	$3B	$42B
Other	$14B	-5.9B	$8B	$6B
Total	$378B		$126B	$252B

It can be seen that biggest cut would be for the procurement of new weapons system. This 64 percent cut would drastically affect not only the future force structure of the military but also the survival of many companies in the US defence industry.

Without the Soviet Union as an enemy, all the forces that had been developed to deal with the Soviet threat would now have a greatly diminished value. What good is an attack submarine if there are no SSBNs to hunt?

To achieve this level of budgetary reduction, a slimming exercise at a health club would not do. Muscles on the top of fat would have to be shed. Reagan's goal of a 600-ship Navy was not achieved before it was scaled back to a more sustainable level. This had to be accompanied by a draw down on the number of officers and sailors recruited for the 600-ship Navy. This cutback on personnel would haunt the US Navy for 20 years.

Besides the US, other European countries also saw the requirement to invest in defence sharply reduced with the evaporation of the Soviet threat. A 30 percent cut in the defence budget became the order of the day. Similar to the US, the major budget cut would fall on capital procurement. With a reduction of some 50 percent of the budget for procurement, it became a challenge to the armament procurement agencies to stretch the dollar. Some efficiencies could be achieved with the adoption of commercial procurement practices. This was done. The US DoD tore up its books on managing acquisition and wrote new ones. The UK MOD had earlier employed Lord Peter Levene, the chairman of a company, United Scientific Instruments, to be the Chief Procurement Executive. The French Armament authority, DGA is presently headed by Mr Hemmer, former President of Peugeot.

The best commercial procurement practice could perhaps save 20 percent of the procurement budget. Further efficiencies must come from the creation of innovative ways of war fighting and to buy new systems to enable these new ways of war fighting.

The US Joint Chiefs of Staff with Admiral Owen as its spokesman pushed for the development of a system of systems for war fighting and to achieve Information Dominance for the US Armed Forces in its new role as the only super power and policeman of the world.

The reduction in defence budget in the West has created a window of opportunity for the countries that buy weapons from them. Advanced technological weapons that were hitherto not releaseable were being offered for sale in order to sustain the defence industrial base. For countries which can benefit from the release of advanced defence technologies, there is an opportunity to acquire them and make their weapons superior to those on the market.

Lean Production: The Machine That Changed the World

RCP: Military Value vs Book Value

As we all know the Relative Combat Power (RCP) of two forces cannot be measured by just counting physical assets. The value of a business is many times the value of its physical assets as indicated by its book value. The military value of a

fighting unit, a tank battalion, a fighter squadron, a missile corvette squadron is many times the cost of the hardware it operates. The leverage is in the intangibles, i.e. the quality of its people, doctrine and relationships and confidence and trust between units. The intangible value of fighting units should increase with each level aggregation. For example, the military value of a brigade must be significantly more than the sum of the value of its constituent battalions. The synergy that can be achieved with the battalions fighting together is however offset by the time and staff resources needed by the Brigade Commander to plan and co-ordinate all the activities of the entire brigade.

Information technology has been used to support the staff-work of the brigade staff and has led to an improvement in the agility of a brigade. A computerised C2 System with an electronic map that shows own forces and enemy forces in realtime, a planning system that can test plans and an order dissemination and reporting system has been proven to be a very cost effective way to improve military value. A computerised C2 system was a real force multiplier for the military that first operationalised it. But the military value goes down when both contending forces are similarly equipped. The leverage would then depend on the staff who can use their system in a more innovative way.

Advances in information technology has however not changed the business of war fighting in the same degree as in other businesses like, banking, retailing, manufacturing and air travel.

There is much that we can learn from the world of business and apply to the business of war making besides just the exploitation of information technology to do business differently.

Learning from the Business World

There are countless examples in the business world in which a small company which came from no where, beating the giants of its industry in a relatively short time. Some modern examples are Toyota, Wal-Mart and Microsoft. Toyota makes cars, a prime product of the industrial age, which has changed the way we live. Wal-Mart is a retailer, using information age technology to sell products more effectively than its competitors. Microsoft makes software, a knowledge product of the information age which has become as ubiquitous as electricity and provided mankind with the power to do things more efficiently. Toyota is an example of how to succeed by daring to do things differently. The company pioneered the new production process commonly known as the Lean Production which found its way into aircraft companies like Lockheed Martin in the early 1990s.

Toyota's background

Toyota was founded in 1937 by Kiichiro Toyoda. Soon after its incorporation, the company was forced to build trucks for the war effort by the Japanese military government. After the end of World War II, the company struggled to build cars by the craft method i.e. handmade. At the end of 1949, the company had to retrench a quarter of its workforce because of recession and they could not sell their cars. The workers went on strike and returned to work only after Kiichiro Toyoda resigned. By 1950, 13 years after the company was formed, it had produced only 2,685 cars. At that time Ford was pushing out 7,000 cars a day from its Rouge Plant at Detroit, the most modern and efficient car-producing plant in the world.

In the spring of 1950, Eiji Toyoda, a nephew of Kiichiro spent three months at the Ford's Rouge Plant. He reported to HQ that he "thought there were some possibilities to improve the production system".

Mass production as perfected by Ford was obviously not a model for Toyota. To survive as a car producer, they had many problems to overcome. The main problems were:
· Tiny domestic market which required a wide range of vehicles.
· New labour law introduced by General McArthur restricted the sacking of workers.
· Lack of funds.
· Foreign competitors.

The Japanese government responded to foreign competitors by prohibiting direct foreign investment in the Japanese motor industry. Car imports were kept out with a high tariff barrier. The domestic car manufacturers resisted the government's move to merge them to make them more competitive against the "Big Three" car makers in US.

Toyota had the impossible task of trying to compete with the most efficient mass producers of cars in Detroit. Even if they had the capital to buy a modern car producing plant from US, they would not be able to compete with Detroit as they did not have the same economy of scale nor the same know-how in running plants.

Fortunately for Toyota, they did not have money to throw at the problem. To compete they have to find a different way to make cars and to beat the Americans. A tight budget is not necessarily a bad thing as it forces one to exercise one's mind to come up with innovations. Taiichi Ohno, the creative chief engineer of Toyota, was forced to innovate.

Ohno's Innovation in Car Making

Car bodies are made by welding some 300 metal parts stamped from sheet steel. Manufacturing begins with the "blanking" press to produce a stack of flat blanks from a roll of sheet steel. The blanks are then inserted into massive stamping presses which press them into 3-dimensional parts. The massive and expensive presses then in production were designed to meet the mass production needs of the "Big Three" car manufacturers in Detroit for maximum production rate. These presses could punch out a million parts a year operating at 12 strokes a minutes, 3 shifts a day.

But Toyota made only a few thousand cars a year. These presses could be retooled to make different parts but the changing of the massive dies would require specialist technicians more than one day to make the change. A couple of such presses would be sufficient to make all the parts for Toyota's cars. The only snag: after each production run of a few hours the presses would lie idle for 24 hours for retooling. What would the workers do during retooling? How to compete with Detroit with such low productivity?

Toyota's chief engineer Taiichi Ohno solved this problem with the design of new tools on rollers. He made tool changing so simple that it would need only 3 minutes. Now it would make economic sense to change tools after every few hours. The process of tool changing was so easy that the production workers could do it as part of their work.

Ohno discovered that making small batches of stampings cost less per part than large production lots. This was against conventional wisdom of economies of scale. He found that he could achieve a lower unit cost because he was carrying a smaller inventory cost and there was less wastage. An error of stamping would be detected as soon as the part was used and so large quantities of defective parts to be reworked or thrown away in mass production plants could not happen in Toyota.

This also led to the Just in Time Inventory system in which suppliers delivered components directly to the production line just in time for their assembly into the vehicles. In 1985 Toyota carried about two hours' worth of parts inventory in their factories.

The workers in Ohno's factory would have to be multi-skilled and highly motivated. If workers did not prevent problems from happening, the whole factory would come to a halt.

The lifetime employment of workers required by the new labour law imposed by the Americans made the hiring of each worker a deliberate act as they would

become a member of the Toyota family for life. Investment in the continual training of workers would made sense as they would become an appreciating asset by learning and improving their contribution to the company over their lives.

In exchange for this iron rice bowl i.e. job security, the employees of Toyota had to agree to be flexible in work assignments and to be active in promoting the interests of the company by initiating improvements rather than merely doing what they were told to do. In mass production factories in the Detroit, the workers were not required to think. They were told to "leave their brains at the door" when they reported for work. In Toyota they were required to use their brains in their work.

It took Toyota more than 10 years to prefect Lean Production. Other Japanese car makers followed their success. In 1955, Japan made less than 1 percent of the cars in the world. 30 years later in 1985, Japan captured 28 percent of the world motor vehicle market.

The superiority of Lean Production can be seen in the following comparison table of productivity of General Motors and Toyota:

	GM	Toyota
Gross Assembly Hours	40.7	18.0
Net Assembly hours	31.0	16.0
Assembly Defects/100 cars	130	45
Inventories Parts	2 weeks	2 hours

Toyota took half as much time as GM to make a car with 35 percent less defects. The amount of inventory of parts carried by Toyota was less than 6 percent GM's.

Lesson on Lean Production

The lesson to draw from Toyota is not how to make cars more efficiently but daring to break away from conventional solutions to meet our operational requirements. The availability of technology is usually not a problem. We can buy technology or employ technologists to develop the technology needed. It is not the technology of weapon systems but the technology of motivating, organising forces and the boldness to do things differently from conventional practices that will create higher military value.

Our challenge is to dare to dream. We must dare to dream about doing things differently and be able to make the dream a reality. The following Dare to Dream cycle shows how dreams can be transformed into operating capabilities:

The Dare to Dream cycle is a learning cycle of thinking, doing and observing. One gets bolder with each cycle as each success will inspire greater successes.

TECHNOLOGICAL SOLUTION FOR BUDGET-TIGHT ARMED FORCES

Tight Budget is Not Necessarily Bad

A shortage of budget to build the forces needed for operational capabilities will challenge us to think of unconventional solutions. The challenge is not to create more operational capability with more money. Anybody can do that. Only an intelligent and daring armed force can create more operational capability with a small budget. Information technology has enabled businesses to achieve quantum jumps in their performance by giving them the means to create new ways to compete. The same could also be achieved in the business of war fighting.

Positive Example of Information War

The Israeli Airforce (IAF) in 1982 demonstrated how a high-tech war in the Information Age should be fought. Electronic jamming and deception denied the Syrian Airforce of a current Air Situation Picture whereas the IAF had a realtime Air Situation Picture. In every dog fight, the IAF had information dominance with the final score of 80 kills to one loss. The Syrian pilots were also psychologically defeated by their fear of the F-15s which had just been delivered and constituted only a small fraction of the IAF. It was the welding of information warfare systems with tactics that made such an astounding success possible.

Negative Example of Information War

The US Air Force in Desert Storm used an average of 11 tons of PGMs or 44 tons of bombs to destroy each target. In the first five days of the war when low-level tactics were employed to avoid medium-level SAMs, some 31 USAF and allied fighters were shot down. This worked out to be 6.2 losses per 1,000 strikes. The ban on flying below 12,000 feet to avoid shoulder launched SAMs and AAAs reduced aircraft attrition but it also reduced the effectiveness of PGMs as most of them did not have a clear line of sight to their targets.

The Americans had high resolution images from space. But these images belonged to the CIA and were not released to the ground commanders until it was too late. There was insufficient Battle Damage Assessment which resulted in multiple attacks on the same target. The air campaign became a war of massive use of force instead a war of precision. The aircraft most feared by the Iraqis was not the high-tech stealth fighter F-117 but the aged B-52s with a belly load of 100 dumb bombs.

The CNN reports on TV of one bomb destroying one target was only propaganda to convince the Americans back home that they would win the war with high-tech weapons without spilling precious blood.

The lesson to be learnt from the Gulf War is the need to integrate resources and information across organisations as the cost of not using information would be very high as demonstrated by the USAF's score of 11 tons of PGMs or 44 tons of dumb bombs to destroy a target. No other country would have the luxury of time, quality and quantity of forces employed by the US in *Desert Storm*. Therefore try not to imitate what the Americans did in *Desert Storm.*

Information vs Inventory

In the business world information has driven out inventory. *Just-In-Time* delivery of goods and services has achieved dramatic improvements in service level and reduction in costs. Toyota carries just two hours of parts in the factory. For the military, the greatest leverage of a balanced combination of information systems and guided weapons would be in the elimination of reserves. Maintaining reserves to cover lack of intelligence, uncertainties and the fog of war is the standard practice in the military. Following the doctrine of keeping one-third of the forces in reserve will result in having contact with 29 percent of the forces. If there is information dominance and a central reserve of highly mobile forces there is an excellent chance of increasing the forces in contact to more than 50 percent. Think how many more things you can do if you dare to go flat out with no reserves but trusting in the higher echelon to provide reinforcements when required with having to ask.

The investments necessary for victory in the information arena to achieve information dominance will enable successful manoeuvre warfare and destruction missions, with much smaller expenditure of weapons and losses than what was experienced by the Americans in Operation *Desert Storm*.

TECHNOLOGICAL SOLUTIONS FOR MANPOWER-TIGHT ARMED FORCES

· Lean Production

In mass production factories, workers are not required to use their brains. They are supposed to leave their brains at the door when they report for work. In *Lean Production*, every worker is expected to contribute ideas on how to improve the operation of their plant. *Lean Production* has displaced mass production in many factories around the world. With better educated soldiers there is greater scope for their development. We can expect significant savings in manpower substituting quantity with quality.

· **Automation**

A second technological solution is the greater use of automation. The US Navy has set a target of 95 sailors to crew the DD21 destroyer under development, a reduction of 305 from the current manning of 400 for a destroyer.

· **Manpower Savings**

But even if we introduce no new technology we can still achieve a significant reduction in manpower if we do not waste time. Another way to look at this issue is how to maximise the utilisation of our forces. If time is managed as tightly as money we would be able to detect all the waste that is going into waiting or doing things that add little to military value.

Tradition is the Greatest Obstacle to Change

Ohno of Toyota designed the tools for his presses to be changed in three minutes as compared to the 24 hours in other car producing factories. As the US Navy Smart Ship project team has found, the greatest obstacle to the reduction of manpower for ships was tradition. To reduce manning by doing things differently will require officers with daring. It is comforting to follow the footsteps of others. It is less risky. To build up a sustainable competitive advantage over your potential enemies, one has to learn continuously and dare to be a pioneer. One must dare to dream and have the perseverance and fortitude to fight for one's ideas and make one's dreams come true.

Whither the RMA?

Schnaubelt, Christopher M.
Parameters, Autumn 2007

"From Alfred Nobel's prediction that dynamite was such a radical change that it would lead to the end of war, to similar claims about the machine gun, the naval torpedo, the bomber, and the nuclear bomb, predictions of revolutionary change in warfare have been commonplace — and wrong."
— Mackubin Thomas Owens[1]

The strategic importance of technological improvements in US military capability is a key but insufficiently examined issue in the transformation of today's military.[2] Is the present Department of Defense (DOD) attempt at transformation, which focuses on technological solutions to increase capabilities, being misguided by a vision of a high-tech Revolution in Military Affairs (RMA)? This question is particularly relevant with regard to attempts to use information management and networked systems in lieu of increased firepower, better armor, and more manpower. The current effort may well be leading America's military in the wrong direction.

This article suggests that DOD's endeavors to pursue technical improvements in warfighting functions where US forces already display dominance have been excessive to the point of being counterproductive. Organizational changes based upon assumptions of an ongoing RMA have already placed at risk the ability to achieve a rapid victory in Iraq. The minimal size of ground forces deployed and available for Operation Iraqi Freedom was the result of planning to fight the war we envisioned, with RMA-capabilities we hoped for, instead of the enemy and conditions we would actually face. The relatively small force employed for the initial ground war was stupendously successful, but rapidly lost its effectiveness during subsequent stability and security operations. Failing to adequately think past the first move, senior decisionmakers ignored the old adage that "the enemy gets a vote."

America's undisputed dominance of conventional maneuver warfare means that intelligent, adaptive enemies will engage us with asymmetric strategies and tactics. The current transformation efforts are not yet capable of meeting this challenge. If the wars of the twenty-first century will primarily involve rogue regimes and failed states, even exponential increases in traditional combat capabilities are likely to produce only marginal improvement in our ability to achieve the larger political objectives. While trying to get even better at the tasks in which America's military already excels is prudent, this goal should not be pursued at the expense of fixing vulnerabilities that current and future enemies are likely to exploit using

asymmetric strategies and tactics. In particular, DOD would be better served by improving its ability to coordinate and execute interagency operations that support employment of the entire range of national power — a critical improvement that is likely to require more personnel instead of less and greater emphasis on human resources rather than technology.

A Historical Perspective

Arguably, the earliest well-documented RMA occurred during the First Punic War between Carthage and Rome. One of the leading city-states, Carthage was the greatest maritime power of the age and possessed major trade routes throughout the known world when the war began in 264 B.C. Its armies had also been widely victorious. Consisting mostly of mercenaries and allied troops led by Carthaginian officers, they had been successful in expanding Carthage's footprint and establishing colonies in Spain, Sardinia, the Balearic Islands east of Spain, Malta, and Sicily while controlling most of the North African coast along the Mediterranean Sea.[3]

Rome, in contrast, was an emerging regional power still fighting to complete its domination of the Italian Peninsula. While its legions were nearly invincible land formations, Rome had no navy. When Rome and Carthage came into conflict over spheres of influence in Sicily, the Carthaginian strategy was to defend from heavily fortified cities and control the seas. Carthage expected the upstart Rome, which had little experience in expeditionary warfare, to eventually wear itself out trying to fight with overstretched lines of communication that it could not protect.

Determined to defeat Carthage, in 261 B.C. the Roman Senate made the strategic decision to build an initial fleet of 120 warships. In addition to rowers, each ship carried a complement of approximately 125 soldiers. The Romans did not fare well in the initial sea battles; they could not match the Carthaginians in terms of skill and tactic. However, the Romans developed a technological leap: the *corvus* (raven), a boarding bridge with a beak-like spike on the end that the Roman vessels used to latch on to enemy ships and permitted their soldiers to storm aboard the Carthaginian vessels. This innovation practically turned naval engagements into land warfare, the type of battle in which the Romans excelled. In 260 B.C. at Mylae, 258 B.C. at Sulci, and 257 B.C. at Tyndaris, the Romans won major naval engagements. Finally, in 256 B.C., the Romans defeated the entire Carthaginian fleet off Cape Ecnomus (southern Sicily), setting conditions for the invasion of Africa and the siege of Carthage.

Initiating a RMA, the *corvus* permitted the Romans to use their superlative skill in land battle to achieve victory at sea. However, the success of the *corvus* first required the strategic willingness to venture into naval combat — a new domain of warfare for the Romans. Furthermore, before boarding enemy ships with their infantry Roman warships first had to master maritime navigation and develop the

rowing skills necessary to maneuver against enemy vessels. Roman admirals had to learn to provide expeditionary logistical support and to command and control their fleets at sea. The *corvus* did not merely improve Rome's existing capability in naval warfare, it enabled Rome to effectively compete victoriously in this new domain.

This RMA did not make the Romans invulnerable to the vicissitudes of war. It took the Romans another 20 years to win the First Punic War following the introduction of the *corvus*. Many of the land campaigns, where the Carthaginians defended strongly fortified cities, were stalemates despite Roman mastery of land warfare. Good fortune also played a role. In 255 B.C., the Roman fleet lost two-thirds of its ships in a storm that resulted in the drowning of almost the entire army. That same year, the proconsular commander of the army besieging Carthage, Marcus Atilius Regulus, blundered at the Battle of Bagradas. The Spartan general Xanthippus (hired by Carthage to defend the city) used elephants to shatter the tight ranks of the legions, defeated the Roman army, and captured Regulus. Additionally, it was about this time that the Carthaginians began to develop maritime tactics to counter the advantage of the *corvus*. Those new tactics resulted in their winning a major naval engagement at Drepana in 249 B.C. This was the Romans' worst defeat at sea during the First Punic War. It was quickly followed by the remainder of the Roman fleet being shipwrecked by another tempest.

When the First Punic War was finally settled on terms highly favorable to Rome, another successful land battle played a critical role after the Romans laid siege to Carthage. The *corvus* was revolutionary technology that gave the Romans an advantage which they successfully exploited in a totally new domain. This RMA, however, was not by itself decisive nor did it permit Rome to ignore the other elements of warfare necessary to win against Carthage. Conventional victory on land was still required despite the revolutionary effectiveness of the *corvus* at sea. A tactical error, as occurred at Bagradas, could (and did) result in the loss of an entire campaign. Furthermore, the Romans had to master the basics of warfare in a totally new domain — the sea — in order to successfully employ the *corvus*.

American Visions of an RMA

Initial speculation about a twenty-first century RMA was based upon leaps in military technologies — especially information technology — and by the ability of American armed forces to leverage these advances.[4] According to David Gompert, "the revolution's mortar and pestle are stand-off weapons and information dominance — that is, complete knowledge of what all enemy and friendly forces are doing."[5] With an unparalleled ability to detect enemy forces and rapidly deliver precision munitions against high-value targets throughout the depth of the battlespace, US forces were expected to decisively outmatch any potential adversary and fully dominate every military contest. Joint fires, "in most cases, USAF-supplied air

support," would largely replace field artillery.[6] The improved ability of the joint force to strike virtually any target at any location when combined with greater mobility and lethality implied the need for a much smaller tactical footprint and fewer ground forces.

The impact of a posited RMA, and its implications for force structure, has been hotly debated. Following Operation Allied Force in 1999, some analysts argued that the campaign over Kosovo demonstrated the capability of joint and combined airpower to force enemy capitulation without the need for boots on the ground. Charles Dunlap, for example, wrote: "Indeed, Allied Force was the first major operation in which aircraft achieved victory without the need for a land campaign. What really encouraged airpower enthusiasts was the apparent vindication of decades-old theories that air attacks could achieve a psychological effect on an enemy that would force it to yield even when its military remained in the field able to resist."[7] Without employing ground forces in combat operations, according to champions of RMA theory, the air campaign achieved the military objective stated by then-Secretary of Defense William Cohen: "to degrade and damage the military and security structure that President Milosevic (Yugoslav President) has used to depopulate and destroy the Albanian majority in Kosovo."[8]

Yet other writers have disagreed with the hypothesis that airpower single-handedly resulted in victory, pointing out the role played by the Kosovo Liberation Army (KLA) and asserting that the threat of ground force employment by the United States and its allies was a critical factor in Milosevic's decision to capitulate.[9] Furthermore, while airpower alone may have arguably been sufficient to force the withdrawal of the Yugoslavian military from Kosovo, achieving the larger political goals required a significant influx of peacekeeping forces, a mission that continues with an American brigade remaining in Kosovo today.

Initial impressions of the rapid collapse of the Taliban in Afghanistan also seemed to highlight the capability of airpower in the absence of staging bases and a lengthy buildup of ground forces. US Special Operations forces were inserted to work with elements of the Northern Alliance and target precision-guided munitions delivered from the air.[10] Stephen Biddle describes the "Afghan Model" as "SOF-guided bombs doing the real killing at a distance. . . . All [local allies] have to do is screen US commandos from occasional hostile survivors and occupy abandoned ground later on. America can thus defeat rogues at global distances with few US casualties and little danger of appearing to be a conquering power."[11] The recent resurgence of Taliban attacks raises doubts about what once appeared to be an enduring success for US airpower in support of local forces with minimal employment of American ground units. There is no question that the Taliban was militarily defeated. Its ability to regenerate and threaten US goals for Afghanistan shows something was missing from the American military's initial campaign —

perhaps a holistic stability, security, transition, and reconstruction effort.[12] As history has frequently demonstrated, a determined enemy will reorganize, rearm, and attack again if provided a sanctuary from which to regenerate.

Operation Iraqi Freedom

Informed by the experiences in Kosovo and Afghanistan, and imbued with a belief in US technological dominance, the Department of Defense adopted a campaign plan for Iraq with a relatively minor role for Army and Marine Corps units. Great expectations were created on the belief that a massive hail of cruise missiles and bombs falling upon Saddam Hussein and his leaders would produce the "shock and awe" necessary to cause "the psychological destruction of the enemy's will to fight rather than the physical destruction of his military forces." As opposed to the "armored armada" required for Desert Storm, if shock and awe had the desired effects there would be no need for an Operation Iraqi Freedom (OIF) ground campaign.[13]

Furthermore, many officials believed that the vast majority of the Iraqi populace would welcome the overthrow of Saddam Hussein and view Coalition forces as liberators. Over the objections of then-Chief of Staff of the Army, General Eric Shinseki, a much smaller ground force was committed to the occupation phase of OIF than many planners thought would be necessary. While General Shinseki estimated that "several hundred thousand troops" would be necessary to occupy Iraq, Deputy Secretary of Defense Paul D. Wolfowitz called this figure "wildly off the mark."[14] Believing that an RMA had already occurred — and that OIF could be the forcing function for transformation — seemed to be a major factor in the Pentagon's insistence on limiting the size of ground forces to less than half of what General Shinseki and others believed necessary.

Although it was certainly a joint effort with a significant ground component, the initial phases of OIF appeared to validate the ability of US (and Coalition) forces to rapidly defeat a much larger military. Saddam's army, which outnumbered Coalition forces on the ground by a ratio of three or four to one, was rapidly defeated. Max Boot described this accomplishment as "one of the signal achievements in military history." Reflecting his belief that it was the result of a successful revolution in US operations, he further argued:

This spectacular success was not achieved easily, however. It required overcoming the traditional mentality of some active and retired officers who sniped relentlessly at Rumsfeld right up until the giant statue of Saddam fell in Baghdad's Firdos Square on 9 April 2003. Winning the war in Iraq first required rooting out the old American way of war from its Washington redoubts.[15]

RMA Skepticism

Yet roughly a year later, with insurgents dramatically threatening Coalition control in Najaf, Kut, and Fallujah, it began to appear that much of the "sniping" had merit. Toppling Saddam's regime as well as his statue only partially achieved OIF's strategic objectives. As Steven Metz and Raymond Millen dryly note, "the intervention in Iraq went very well from a military perspective but was significantly less successful once the initial combat abated."[16]

Of the goals listed by Secretary of Defense Donald Rumsfeld during a press conference in March 2003, at least two remain in doubt after more than four years of post-major combat operations: capturing or driving out terrorists from Iraq, and creating the conditions for a rapid transition to a stable representative government.[17] Terrorists such as al Qaeda in Iraq have demonstrated the ability to conduct high-profile attacks on civilians despite the best efforts of Coalition and Iraqi forces to secure Baghdad. Although sectarian violence dropped significantly in January through April 2007 following President George W. Bush's announcement of the "surge," it began to rise again in May.[18] The current government of Iraq was democratically elected, but its level of stability and degree of representing the populace are arguable. Former Iraqi Prime Minister Ayad Allawi, for example, has been trying to drum-up opposition to the current Prime Minister, Nouri al-Maliki, arguing that the present government is too sectarian: "Iraq cannot survive under the current Shia leadership, and Sunnis must have a much larger role in government."[19]

Overwhelming military dominance by the United States (and its Coalition partners) against Saddam's armed forces did not prove decisive in achieving American strategic objectives in Iraq. In his address to the nation on 10 January 2007, President Bush stated that the United States had believed that the elections of 2005 (a stunning achievement) would help unify the Iraqi public. Combined with progress in training the Iraqi police and military, the administration had hoped the elections would mean a reduction in American forces. However, the President subsequently recognized that ". . . in 2006, the opposite happened. The violence in Iraq — particularly in Baghdad — overwhelmed the political gains the Iraqis had made."[20]

Insurgency and sectarian violence remain a grave threat to stability, economic recovery, and the ability of the elected government to responsibly and effectively govern. The situation may not be nearly as dire as some pundits in the media would have the American public believe, and the surge (or perhaps the threat of a subsequent withdrawal of Coalition forces) may yet prove the catalyst for Iraqi national reconciliation. Nonetheless, there is certainly a long way to go before most Iraqi citizens will be living in a safe and secure environment under a broadly representative government.

Several participants at a RAND seminar in 2004 proposed an alternative explanation to the belief that a RMA was responsible for the rapid victory over Saddam's army.[21] They espoused that Saddam had planned for his army to initially melt away then rise to fight as guerillas against Coalition occupying forces; this strategy obviated the US technological superiority. Thus, even the rapid success of the "major combat phase" would not be evidence of a successful RMA because the war for control of Iraq was designed to be continued by guerillas and insurgents. Seymour Hersh offered a similar observation:

We're told we are fighting an insurgency there. "Insurgency?" No way. They're the people we went to war with: the Sunnis, the people we thought we beat. It's not an insurgent movement; it's the original war, now being fought on their terms.[22]

It is worth noting, however, that suggestions of a "melt away" strategy on the part of Saddam's army are highly speculative. Virtually no evidence has emerged to indicate that Saddam even considered such a contingency, much less planned and put the pieces into place to continue the fight after his military was defeated. Indeed, it appears he was genuinely surprised when the Coalition routed his forces and attacked into Baghdad.[23]

Saddam did not expect the United States to risk the casualties inherent in an operation on urban terrain, and hamstrung his military commanders due to fears of an uprising or coup.[24] It appears that the surprise deployment of the Fedayeen Saddam paramilitary fighters was a result of Saddam's plans to control the Iraqi populace, not a Fabian strategy to defeat Coalition forces. Whether best described as insurgency, civil war, guerilla war, net-war, terrorism, or a combination of all five of these, the current adversaries in Iraq began their attacks as an ad hoc effort that has become increasingly well-organized and sophisticated. At least prior to "the surge," the ability of our enemies to introduce additional combatants into the theater outpaced the US and Coalition force's ability to capture or kill them.

Despite the lightning-quick defeat of Saddam's army and the destruction of his regime, US and Coalition forces are no closer to creating a secure environment and forming a stable, democratic Iraqi government than might have been expected from a less capable but larger "low-tech" force. One might even argue that the belief in RMA has retarded progress in Iraq. Because fewer ground forces were necessary to defeat Saddam's military, there were subsequently fewer units on-hand to conduct post-major combat operations — particularly counterinsurgency operations. How could a "successful RMA" have resulted in a reduced ability to achieve our strategic objectives?

A New Type of Warfare?

Analyzing trends in insurgency since the advent of Mao's People's War, Thomas Hammes has published a robust critique that illustrates how over reliance on technology at the expense of human capabilities has resulted in the long, hard-slog the United States is currently experiencing in Operations Iraqi Freedom and Enduring Freedom. In *The Sling and the Stone*, Hammes argues that DOD is losing its warfighting dominance because it "did not want to deal with the manpower intensive, low-technology conflicts that were actually taking place around the world. It was much more comfortable to theorize about future high-technology conflicts with 'near-peer competitors.'"[25]

According to Hammes, DOD planning documents intended to guide strategic planning for the future — such as *Joint Vision 2010* and *Joint Vision 2020* — are built around third generation warfare (3GW). 3GW is combined arms maneuver warfare that attempts to eliminate an enemy's will to fight by destroying his logistics and command and control capabilities. 3GW thinking was initiated by the Germans in World War I, but emerged to its zenith with the Nazi Blitzkrieg in World War II. It continued to develop through US military doctrine as a way of defeating numerically superior Soviet armies in Western Europe, being incorporated into concepts such as Air-Land Battle, and is reflected today in the latest *Joint Vision* expression of national military strategy.

Meanwhile, Hammes argues our most dangerous adversaries are successfully using fourth generation warfare (4GW) against us. He defines 4GW as using "all available networks — political, economic, social, and military — to convince the enemy's political decisionmakers that their strategic goals are either unachievable or too costly for the perceived benefit. It is an evolved form of insurgency."[26] He credits Mao's strategy of People's War as heralding 4GW.

Accordingly, "the fundamental strength of 4GW lies in the idea or message that is the heart of the concept." This requires a detailed understanding of the history, culture, and other human and situational factors that cannot be addressed by technology alone. Yet instead of addressing the "complex political, economic, and social aspects of the conflicts we are currently facing," current DOD transformation strategy focuses instead "on technological solutions to problems at the tactical-level of war."[27] Thus, the failure of the US national security establishment to evolve to 4GW has provided our adversaries the ability to overcome any tactical advantage we might have gained in 3GW. It also calls into question the ability of American forces to successfully perform what the US Army calls "operational art:" the ability to translate strategic aims into a logical series of tactical missions.[28] The belief that warfare evolves in generational waves is a highly debatable hypothesis.[29]

Nonetheless, Hammes' critical appraisal of DOD transformation efforts are well-taken. He notes: "Much to the surprise of the *Joint Vision 2020* proponents, the insurgents have proven largely immune to our technology."[30] Even Antulio Echevarria, a harsh critic of 4GW theory, agrees that "the fundamental rub . . . is how to coordinate diverse kinds of power, each of which operates in a unique way and according to its own timeline, to achieve specific objectives, and to do so while avoiding at least the most egregious of unintended consequences."[31]

The Real RMA?

Seven years ago David Tucker presciently raised concerns that an RMA would cause military capabilities to outpace interagency coordination and planning. He warned:

Rapid simultaneous engagement of the enemy will not always result in the simultaneous cessation of all hostilities. Disintegration may induce some of the enemy's forces to surrender, but others will fight on in isolation as cohesive units, perhaps retreating to nearby urban areas, while others transition to guerrilla warfare. The military, therefore, will be conducting high-intensity operations in one spot, while in other places it mops up, provides humanitarian assistance, takes care of refugees, and implements the transition to a legitimate civilian authority, in these latter cases working closely with other agencies.[32]

True, the United States has demonstrated the ability to quickly crush an adversary's numerically superior conventional military formations and depose an enemy regime through force of arms. However, this dramatic increase in high-tech military capability has not translated into an improved ability to achieve the strategic objectives that military power is intended to enable. Instead of improving the ability to achieve political aims, the unforeseen result of DOD's current vision of an RMA is a tactically more dominant military in a time when traditional military force is not as useful as it used to be. Meanwhile the ability to apply the other elements of national power is left lagging.[33]

In *On War*, Carl von Clausewitz posited:

No one starts a war — or rather, no one in his senses ought to do so—without first being clear in his mind what he intends to achieve by that war and how he intends to conduct it. The former is its political purpose; the latter its operational objective. This is the governing principle which will set its course, prescribe the scale of means and effort which is required, and make its influence felt throughout down to the smallest operational detail.[34]

Unfortunately, DOD's current approach to transformation has nurtured a belief that the tactical benefits of a technological-RMA would either eliminate the requirement to link tactical actions with military strategy and political policy, or would make operational art so simple it was a problem that would solve itself. The panoply of technology currently employed in Afghanistan and Iraq has not produced strategic victory.

Clever and determined adversaries, forced to cede the conventional battlefield, have turned to asymmetric attacks that have proven remarkably resilient against conventional combat operations. The US military may be losing ground in the area where it is most vulnerable: the ability to influence civilian populations and — in concert with other US government agencies, allies, and international organizations — to provide basic needs and economic growth while concurrently developing national political structures and governing capacity.

Even if the much-vaunted technology-RMA did occur, it ironically appears that military power alone — whether executed by air or ground forces — may now be less strategically decisive than has historically been the case. In virtually every war the United States won in the nineteenth and twentieth centuries, defeating the enemy's military and occupying his capital equaled strategic success and the achievement of political goals.[35] Furthermore, in an era in which enemies recognize that the United States possesses tremendous military superiority, their logical response is to avoid traditional confrontation. Even at the tactical-level the value of military superiority may be limited in today's operating environment.

Terry Pudas, the Acting Director of the Department of Defense Office of Force Transformation, outlined DOD's goals for transformation:

In information age operating environments, where rapid change and ambiguity are the norm, [the] competitive advantage often depends on the availability of multiple effective options. If US military forces can accelerate the rate of transformation to generate more actionable and effective options than potential opponents, narrow the range of potential successful actions that opponents believe are available to them, and maintain initiative by implementing effective options, then they will be able to impose overwhelming complexity on opposing decisionmakers.[36]

This conceptualization of improvements in relative military capability strongly depends upon adversaries who operate in hierarchical organizations, enemies that choose to engage in conventional warfare, and whose decisionmaking processes mirror those of the United States. In other words, enemies with armed forces similar to ours, enemies that fight the way we would like them to. The record to date in Afghanistan and Iraq shows that adversaries using asymmetric tactics and networked organizations have not been overwhelmed by the complexity of US and Coalition

operations. Indeed, "overwhelming complexity" can only be imposed on those who choose to manage theater-wide efforts in a manner similar to modern armies. This concept is meaningless when applied against non-conventional forces with dispersed decisionmaking structures.

Rather than forcing the pace of the enemy's decision cycle, one could instead argue that American efforts became reactive once conventional "kinetic" combat operations toppled the Taliban and Saddam. When terrorists and insurgents began to use improvised explosive devices and suicide bombers to attack, the United States appeared to react slowly in providing units better body armor and armored vehicles. As terrorists began to conduct high-profile attacks against Iraqi citizens as well as Coalition and Iraqi security forces, the United States was also slow in adopting a counterinsurgency strategy. The terrorists and insurgents control virtually no terrain in a military sense and have zero-chance of achieving their long-range political goals of returning the Bathists to power, reestablishing Sunni supremacy in Iraq, or creating a Wahabbi caliphate. They do, however, dominate the media to the point where Senate Majority Leader Harry Reid has publicly declared that the United States has lost the war in Iraq; as a significant portion of the Congress is clamoring for the withdrawal of American forces.[37]

In their critique of technology-centric transformation concepts, Richard Hooker, H. R. McMaster, and Dave Gray write that "war is grounded in the human condition — in the hopes, fears, pride, envy, prejudices, and passions of human beings organized into political communities and military bodies."[38] Welcome to the real RMA. This RMA is far different than most adherents and critics predicted a decade or two ago. Insurgents and terrorists have found their own versions of the *corvus* — the improvised explosive device, the suicide bomber, and the Internet — and have demonstrated that they know how to apply them against what they have identified as America's strategic center of gravity; US political will. Fortunately, although our enemies have been able to stymie a number of our efforts in Iraq they remain unable to achieve their own strategic objectives.

The real RMA will not be purely military. It will be founded on the efforts of strategic thinkers, not tacticians, individuals capable of understanding and integrating all aspects of national power. This new RMA will not be realized until the United States develops an effective system of interagency strategy and operations with the ability to exercise all the elements of national power; including, but not limited to, the diplomatic, information, law enforcement, economic, and military aspects of power; elements of power that can dominate the asymmetric strategies of our enemies.

NOTES:

The author wishes to thank Terrence Kelly, David Kilcullen, H. R. McMaster, Katherine Underwood, and Rick Waddell for their invaluable advice and assistance.

Endnotes:

1. Mackubin Thomas Owens, "Transformation: The Changing Requirements for Victory on the Battlefield," *The Weekly Standard*, 23 January 2006, 38.

2. The Acting Director of the Department of Defense Office of Force Transformation, Terry Pudas, has written that transformation has "replaced the earlier phrase, revolution in military affairs (RMA) in DOD. RMA connoted rapid, radical and uncontrolled change — an uncomfortable notion for many military professionals." Further, the ambiguity of the word "transformation" was an advantage in consensus building. (Terry J. Pudas, "Disruptive Challenges and Accelerating Force Transformation," *Joint Force Quarterly*, 42 (3d Quarter 2006), 47.)

3. See Adrian Goldsworthy, *The Punic Wars* (London, Eng.: Cassell, 2000).

4. Readers who desire a more thorough review of the various perspectives on RMA may wish to visit the Project on Defense Alternatives RMA page at http://www.comw.org/rma/index.html.

5. David C. Gompert, "The Information Revolution and U.S. National Security," *Naval War College Review*, 51 (Autumn 1998), 30.

6. Adam J. Herbert, "Army Change, Air Force Change," *Air Force Magazine*, 89 (March 2006), 37,
http://www.afa.org/magazine/march2006/0306army.html.

7. Charles J. Dunlap, Jr., "Special Operations Forces After Kosovo," *Joint Force Quarterly*, 28 (Spring/Summer 2001), 7.

8. See "Operation Allied Force," 21 June 1999,
http://www.defenselink.mil/specials/kosovo/ and "Kosovo: An Account of the Crisis," http://www.kosovo.mod.uk/account/nato.htm.

9. The debate regarding airpower versus ground forces in Kosovo is extensive. For example, see the series of articles in *Air Force Magazine Online*, http://www.afa.org/magazine/perspectives/balkans.asp.

10. The efforts of the Kosovo Liberation Army in Kosovo may have presaged the

Northern Alliance's role in defeating the Taliban.

11. Stephen Biddle, "Afghanistan and the Future of Warfare," *Foreign Affairs*, 82 (March/April 2003), 31. Biddle notes, however, that "contrary to popular belief, there was plenty of close combat in Afghanistan," 32.

12. Department of Defense Directive 3000.05, *Military Support for Stability, Security, Transition, and Reconstruction (SSTR) Operations*, 28 November 2005, provides guidance for Department of Defense activities that support US government plans for stabilization, security, reconstruction, and transition operations, which lead to sustainable peace while advancing US interests.

13. CBS Evening News, "Iraq Faces Massive U.S. Missile Barrage," 24 January 2003,
http://www.cbsnews.com/stories/2003/01/24/eveningnews/main537928.shtml

14. See Eric Schmitt, "Pentagon Contradicts General on Iraq Occupation Force's Size," *The New York Times*, 28 February 2003, http://www.globalpolicy.org/security/issues/iraq/attack/consequences/2003/0228penta goncontra.htm.

15. Max Boot, "The New American Way of War," *Foreign Affairs*, 82 (July/August 2003), 44-45, http://www.foreignaffairs.org/20030701faessay15404/max-boot/the-new-american-way-of-war.html.

16. Steven Metz and Raymond Millen, "Intervention, Stabilization, and Transformation Operations: The Role of Landpower in the New Strategic Environment," *Parameters*, 35 (Spring 2005), 43. Metz and Millen argue that the Army can no longer be satisfied with "simply defeating enemies on the battlefield" but must subsequently turn "them into nonbelligerents, allies, and friends," 51.

17. Jim Garamone, "Rumsfeld Lists Operation Iraqi Freedom Aims, Objectives," American Forces Press Service, 21 March 2003, http://www.af.mil/news/story.asp?storyID=32403155.

18. Karin Brulliard, "Bombers Defy Security Push, Killing at Least 158 in Baghdad." *The Washington Post,* 19 April 2007, A1; and CNN.com, "U.S. Commander Points to Progress in Parts of Iraq," 8 June 2007,
http://www.cnn.com/2007/WORLD/meast/06/07/petraeus.iraq/index.html.

19. Associated Press, "AP Interview: Now Critical of U.S., Former Iraqi Premier Appears to Want His Job Back," *International Herald Tribune*, 31 March 2007, http://www.iht.com/articles/ap/2007/04/01/africa/ME-GEN-Iraq-Allawi.php?page=1.

20. George W. Bush, "President's Address to the Nation," 10 January 2007, http://www.whitehouse.gov/news/releases/2007/01/20070110-7.html.

21. "Post-Major Combat Operations in Iraq," RAND Corporation seminar, Santa Monica, Calif., 16 November 2004.

22. Julian Sanchez, "Soundbite: Torture and Defeat," interview with Seymour Hersh, *Reason*, February 2005, 15.

23. Amy Davidson, "How Iraq Came Undone," interview with Jon Lee Anderson, *The New Yorker Online*, 15 November 2004, http://www.newyorker.com/printable/?online/041115on_onlineonly01.

24. See Harry Keisler, "The Invasion and Occupation of Iraq: Conversation with Michael Gordon," 21 March 2006, Institute of International Studies, University of California, Berkeley, http://globetrotter.berkeley.edu/people6/Gordon/gordon-con4.html; and Kevin Woods, James Lacey, and Williamson Murray, "Saddam's Delusions: The View from the Inside," *Foreign Affairs*, 85 (May/June 2006), 2-26.

25. Thomas X. Hammes, *The Sling and the Stone: On War in the 21st Century* (Rpt.; St. Paul, Minn.: Zenith Press, 2006), xii. The seminal 4GW article was "The Changing Face of War: Into the Fourth Generation" by William S. Lind, Keith Nightengale, John F. Schmitt, Joseph W. Sutton, and Gary I. Wilson in *The Marine Corps Gazette*, 73 (October 1989), 22-26. Other 4GW theorists include Chet Richards (see Jesse Walker, "The New Generation of War: Defense Expert Chet Richards on Lebanon, Iraq, and the Future of the American Military," *Reason Online*, 20 July 2006, http://www.reason.com/news/show/36974.html.

26. T. X. Hammes, "Fourth Generation Warfare Evolves, Fifth Emerges," *Military Review*, 87 (May-June 2007), 14.

27. Hammes, *The Sling and the Stone*, 129, 191.

28. Ralph L. Allen, "Piercing the Veil of Operational Art," *Parameters*, 25 (Summer 1995), 111-19.

29. The importance of an idea to rally the forces and encourage others to join one's side is not a new development. Using threats or promises to change the interest calculations of enemy decisionmakers is as old as warfare itself.

30. Hammes, *The Sling and the Stone*, 189.

31. Antulio J. Echevarria II, *Fourth-Generation War and Other Myths* (Carlisle, Pa.:

US Army War College, Strategic Studies Institute, November 2005), 16.

32. David Tucker, "The RMA and the Interagency: Knowledge and Speed vs. Ignorance and Sloth?" *Parameters*, 30 (Autumn 2000), 67.

33. One indicator of transformation drift within DOD may be the activities of the Deputy Under Secretary of Defense for Business Transformation, Paul Brinkley. Charged with reforming the Pentagon's business operations by "working across the military services and defense agencies to drive rapid transformation of business processes and systems to ensure improved support to the warfighter and improved financial accountability," Brinkley actually spends much of his time trying to revive Saddam-era state owned enterprises in Iraq. (See "Mr. Paul A. Brinkley," Biography, http://www.defenselink.mil/bta/leadership/brinkley.html and Scott Kim, "Iraqi Business Restoration Progressing," 27 February 2007, http://www.mnf-iraq.com/index.php?option=com_content&task=view&id=10231&Itemid=128.

34. Quoted in Allen, 111.

35. Admittedly, this statement is somewhat tautological because political goals beyond defeating the enemy's military were rarely conceived prior to the decision to go to war.

36. Pudas, 43.

37. CBS Evening News, "Senator Reid on Iraq: 'This War Is Lost,'" 20 April 2007, http://www. cbsnews.com/stories/2007/04/20/politics/main2709229.shtml.

38. Richard D. Hooker, Jr., H. R. McMaster, and Dave Gray, "Getting Transformation Right," *Joint Force Quarterly*, 38 (3d Quarter 2005), 21-22.

39. Dr. Christopher M. Schnaubelt is the Deputy Director for National Security Affairs, Joint Strategic Planning and Assessment Office, US Embassy Baghdad, Iraq. A colonel in the Individual Ready Reserve, he is a graduate of the US Army War College and received a Ph.D. in political science from the University of California, Santa Barbara. In 2004, he served in Baghdad as the Chief of Policy in the C-5 Directorate of Combined Joint Task Force-Seven.

Speech by Minister for Defence Teo Chee Hean on "Trends in our Security Environment" at the Committee of Supply Debate on Defence Budget 2007.

Mr Chairman Sir, I would like to thank the Honourable Members for their comments and questions, and for their commitment to Singapore's defence and security. I know Mr Low is also very committed to Singapore's defence and security even though he did not state so today.

Trends in our Security Environment

Ms Indranee Rajah and Mr Hawazi Daipi asked about developments in Singapore's security environment. Uncertainty and complexity define the strategic and operational environment today.

The future strategic architecture of our region is now being shaped. With the end of the Cold War, old alignments have dissolved and new relationship patterns are formed. The US is pre-eminent today and will continue to have a key role to play in the stability and security of our region in the future. However, globalisation is changing the contours of the geo-political landscape. By embracing international trade and foreign investment, the world's two most populous countries, China and India have experienced a dramatic transformation. In the period 1993-2004, China's GDP grew by an average of 9.7% a year, India's by 6.5% a year. The economic rise of China and India is changing their security outlook. They are no longer inward looking. As they grow, they will naturally seek to protect their economic interests, such as access to energy, markets and trade routes. They are engaging countries in the region, and expanding their influence by participating actively in regional organisations, deepening bilateral relationships, and strengthening economic ties.

This translation of economic weight into a larger political and military role is driving a re-adjustment by the US and other major powers in the region like Japan. There will be a period of uncertainty as they work out a new modus vivendi. In this more multi-polar world, the region is becoming a complex mosaic of actors. The stage will increasingly be shared between countries like the US, Japan, China and India. And other countries like Australia, a resurgent Russia, and a Europe that is seeking to expand its influence in this economically dynamic part of the world, will also want to play a role. ASEAN will have to work more closely and cohesively together if it is to retain its place in the driving seat of developments in our region.

As strategic re-alignments take shape, we are maintaining friendly defence relations with each of the key players in the Asia-Pacific and engaging them to enhance regional stability.

With the US, the Strategic Framework Agreement (SFA) signed in Jul 2005 provides the foundation. Within this framework, the Strategic Security Policy Dialogue between MINDEF and the US DoD, where both sides exchange views on security issues and explore areas for cooperation, was inaugurated last year. We continue to enjoy close and deep ties with the US. We train together in many bilateral and multi-lateral exercises, and US forces are able to make use of our base facilities including Changi Naval Base. Our F-16, Apache and Chinook detachments have high-end training in the US, and they will soon be joined by an F-15 training detachment.

We are establishing a policy dialogue with China, and stepping up exchanges of visits between the SAF and PLA and the attendance of each other's courses. Our defence relations with India continue to expand in scope, with an annual policy dialogue between MINDEF and the Indian Ministry of Defence. The SAF conducts significant exercises with their Indian counterparts both in India and in Singapore. With Japan, MINDEF and the Japanese Ministry of Defence conduct regular policy dialogues, while the SAF and the Japan Self Defence Force have staff-level talks at both the Joint and Services level and increasing interactions in multilateral and bilateral activities.

These interactions underline our commitment to an inclusive regional security architecture anchored on a strong US presence.

Globalisation undermines old certainties in other ways as well. Businesses are more mobile, communities less rooted, the gaps between skilled and unskilled, rich and poor widening. All this creates dynamism, turmoil, dislocation and sometimes a sense of grievance that breeds conflict. In an inter-connected world, the aftershocks of conflict or extremist ideology in one country can radicalise people in other parts of the world. The Middle East will persist as a source of international terror if governments cannot fight the roots of extremism and radical Islam on their own soil. In Southeast Asia, domestic faultlines centred on religious and ethnic affiliation, if left unchecked, could emerge as potent forces that straddle countries and borders.

Furthermore, compared to the certainties of the Cold War, today's threats have become more complex and fluid. Terrorism is trans-national and driven by non-state actors. It adopts asymmetric strategies and uses technologies in unanticipated ways. This means that in the future our military will not only be called upon to carry out traditional combat operations, but will also have to respond to security contingencies that manifest in unexpected places and in unexpected ways.

It is against this backdrop of international uncertainty that we continue to pursue diplomacy and deterrence — the twin pillars of our defence policy. We have made important advances on both fronts.

Defence Policy

On the diplomatic front, we promote our security by building relationships with friendly countries and armed forces, and contributing to a stable co-operative regional environment and international order.

Ms Indranee Rajah asked about the state of defence co-operation in the region. We have focused on building an open, inclusive regional security architecture that constructively engages extra-regional countries as well. We are working with our ASEAN neighbours to build confidence and facilitate dialogue amongst ourselves and also to engage countries beyond the region that have a stake in regional stability. The establishment of the ASEAN Defence Ministers' Meeting in May last year was a historic development. It was the first time the ASEAN Defence Ministers met. The ADMM will guide the development of an ASEAN defence community that facilitates concrete forms of practical co-operation among regional armed forces. It can also help entrench the open and inclusive ethos of the evolving regional security architecture, by institutionalising the engagement of key extra-regional countries in practical and constructive ways. Singapore will have the honour of hosting the second ADMM later this year.

We play an active role in other regional groupings that enhance security, like the Five Power Defence Arrangements. The FPDA brings together Malaysia and Singapore and anchors its extra-regional partners Australia, New Zealand and the UK in the region. By widening its scope to include cooperation against non-conventional threats such as in maritime security, the FPDA has proved to be an adaptive organisation, relevant to the changing strategic environment and the needs of its members. In Jun 06, the FPDA Defence Ministers further agreed that the FPDA could explore co-operation in Humanitarian Assistance and Disaster Relief.

Mr Arthur Fong asked about how our defence relations, particularly with Thailand, Malaysia and Indonesia have affected SAF exercises and training. The SAF currently conducts exercises and training in about a dozen countries around the world, including Australia, Brunei, France, India, New Zealand, Thailand and the US. So Mr Ang Mong Seng need not be unduly concerned because we do have enough places for us to exercise and to train. The friendly and mutually beneficial relations which the SAF has with the armed forces of these countries add an important dimension to the overall bilateral relations that we have with them, even if from time to time our relations with a particular country may go through a rough patch.

Mr Fong asked about relations with Thailand and Indonesia. The SAF and the Royal Thai Armed Forces have for the last three decades cooperated closely in many areas for mutual benefit. The SAF deeply appreciates and values this close cooperative relationship and the opportunities that this provides for the SAF to train

and exercise in Thailand. We are similarly happy to welcome our Thai friends for visits, exercises and training in Singapore. For example, the Royal Thai Navy is one of the most frequent users of Changi Naval Base, where its ships call for replenishment as they deploy between the Andaman and the Gulf of Thailand. The SAF and the Royal Thai Armed Forces have also worked together in humanitarian relief operations. Following the floods and landslides in Thailand in May 2006, three Chinook helicopters were deployed to assist the Thais in their humanitarian relief efforts. In view of the close defence ties, the RSAF transferred 7 F-16A/B fighter aircraft to the RTAF in 2004. Close defence ties have brought substantial professional and practical value to both our armed forces. Recent developments notwithstanding, both Singapore and Thailand continue to share the view that defence cooperation between our two countries is in the long term strategic interest of both countries.

Singapore and Indonesia also have a long history of defence cooperation, and have trained together regularly since the 1970s. In fact I have the honour of taking part in the first military training exercise between Singapore and Indonesia, Ex Eagle. The SAF and TNI conduct regular bilateral exercises across all three Services. TNI and SAF officers regularly attend each other's command and staff colleges. Fourteen TNI officers have received postgraduate scholarships to attend Masters courses at the Rajaratnam School of International Studies and Lee Kuan Yew School of Public Policy in Singapore. Currently, Indonesian pilots undergo G-tolerance and helicopter simulator training in Singapore. Over the last ten years, 200 Indonesian Air Force pilots have benefited from such training. Familiarity with operating together, as well as strong personal ties between our officers, have allowed the TNI and SAF to work closely in times of need. The combined relief operations that the SAF conducted with the TNI following the tsunami and earthquake in 2004 and 2005 were on an unprecedented scale. The TNI and SAF have a long history of working together in challenging situations, such as when the TNI provided invaluable assistance to Singapore in the search and rescue operations following the SilkAir MI 185 crash in Palembang Musi River in 1997. The TNI and SAF also worked together in hostage rescue operations in West Papua in 1996. An SAF Remotely Piloted Vehicle detachment worked closely with the Indonesian special forces in Timika in West Papua, providing surveillance which proved crucial in facilitating the successful rescue of Indonesian and foreign hostages taken by the Organisasi Papua Merdeka or Free Papua Movement.

To further strengthen defence cooperation between Singapore and Indonesia, PM Lee and President Yudhoyono agreed in Oct 2005 to conclude a Defence Cooperation Agreement (DCA), which will be negotiated in parallel and concluded together as one package with the extradition treaty. The DCA will be an important symbol of the close ties between Singapore and Indonesia, and will provide a framework to enhance our defence cooperation to mutual benefit. The DCA will encapsulate our existing defence cooperation, and allow us to work together on new

projects. We will be able to resume our cooperation in joint projects such as the Air Combat Manoeuvring Range and Air Weapons Range in Sumatra, which were of significant professional value to both our air forces, as well as re-start the Combined Fighter Weapons Instructor Course, the Top Gun Course, to allow fighter pilots from both air forces to train together to improve their skills. Defence officials from both sides have been discussing the DCA, and making progress towards concluding the agreement. While some outstanding issues remain, both sides have shown flexibility and have narrowed differences over these issues in the course of the negotiations. There is a convergence of views on many issues in the DCA. We look forward to working with Indonesia to successfully conclude this Agreement.

Ms Indranee Rajah asked about allegations of violation of Indonesian airspace by RSAF aircraft. I am happy to say that there is no truth to this report. In fact, the PANG TNI, commander of Indonesian armed forces, Djoko Suyanto was reported in the Batam Pos as saying that, "the minute Singaporean fighters take off, they would have passed the border. So since 1980 we have designated Military Training Areas I and II in the South China Sea and in Batam" for RSAF aircraft. He described the manoeuvring of Singapore F-16s at the border as natural and as having nothing to do with provocation or intimidation in response to the sand ban. He added that there have been no reports of any violations by Singapore. All Singapore military manoeuvres into Indonesia are currently carried out in coordination with KOHANUDNAS, or Indonesian Air Defence Command.

Apart from building strong defence ties, we are also making important contributions to international and regional security. We are playing an active role in multi-lateral efforts to enhance maritime security. Mr Hawazi asked about the situation in the South China Sea. There has been no recent escalation in military activities in the South China Sea. In 2002 the 10 member states of ASEAN and China signed the Declaration on the Conduct of Parties in the South China Sea. The signatories affirmed freedom of navigation and oversight in the South China Sea in line with the UN Convention on the Law of the Sea and undertook to resolve territorial disputes by peaceful means, through friendly consultations and negotiations. Such consultations and negotiations continue.

Ms Indranee Rajah and Dr Ong Chit Chung asked how we were co-operating with neighbouring countries to ensure maritime security. Over the last three years, Singapore, Malaysia and Indonesia have jointly launched air and sea patrols to safeguard the Malacca Straits. These efforts have met with encouraging success. In Aug 2006, the London-based insurance body Lloyd's removed its war risk rating for merchant ships using the Straits of Malacca. In Nov 2006, the Regional Cooperation Agreement on Combating Piracy and Armed Robbery against Ships in Asia (ReCAAP) Information Sharing Centre was also officially launched in Singapore. This is the first time regional governments have institutionalised their efforts to

combat piracy and robbery against ships in the form of a permanent body with full-time staff. Dr Ong asked about measures to ensure our ports are safe. Singapore has adopted a comprehensive approach to port security. Since 2003, Singapore has subscribed to the Container Security Initiative. Under this initiative, the Singapore Immigration and Checkpoints Authority works with its US counterpart to screen US-bound containers for material which could be used in weapons of mass destruction. As risks to our ports can also originate upstream in the supply chain, Singapore established the National Supply Chain Security Programme in July last year. In terms of the physical security of our ports, Singapore has a network of sensors ashore and afloat that have been put in place by the Maritime and Port Authority, Police Coast Guard and the RSN. The network enables us to detect potential threats and mount a co-ordinated response in a timely manner.

Dr Lam Pin Min observed that the SAF has made significant contributions to Disaster Relief missions in recent years, and suggested setting up a coordination centre between the SAF and Singaporean VWOs for future such missions. Dr Lam assumed of course that the VWOs want to be coordinated by MINDEF. The SAF deployed for a number of relief operations over the past year. In May 2006, the SAF sent a medical team together with the SCDF to Yogyakarta on a relief mission following the earthquake in Central Java. Over the eight days of relief operations, the SAF medical team treated over 1,400 patients in a field hospital and through mobile medical teams together with the Indonesian authorities. The SAF's C-130 and Fokker 50 aircraft also contributed to relief efforts, transporting equipment and emergency aid from Singapore to Yogyakarta. During that same period, the SAF was involved in another relief operation in Northern Thailand. Three of our Chinook helicopters were deployed there, for flood relief efforts. We also sent SAF medical staff to one of the affected villages, to treat the villagers.

The SAF currently co-operates closely with VWOs for relief operations, for example with the Singapore Red Cross and Mercy Relief during the tsunami relief operations. Given that there is already a good working relationship between MINDEF and VWOs during such operations, setting up a MINDEF-led central co-ordinating body may not be the best approach. VWOs may also decide to carry out humanitarian work on their own where it may not be necessary or appropriate for the SAF to deploy and vice versa.

The SAF also maintained its commitment to peace support operations last year. SAF peacekeepers and monitors were deployed in Aceh in Indonesia and Timor Leste. Our Landing Ship Tank RSS Endeavour carried out a three-month deployment to the Arabian Gulf, followed by a three month deployment of a KC-135 tanker aircraft. Since 2003 we have made three deployments of LSTs and three deployments of KC-135 tankers and one C-130 aircraft deployment to the Gulf. The outcome of the ongoing efforts to stabilise and reconstruct Iraq and Afghanistan will affect us all.

Should the international community fail, the repercussions will be far-reaching. Southeast Asia will not escape the fallout. In today's interconnected world, security and stability are responsibilities that must be shared by all countries that want to live in peace.

The battle against terrorism cannot be won overnight. Neither can the battle against terrorism be won by force alone. We must also win the struggle for hearts and minds. For this reason, Singapore is preparing to provide humanitarian and reconstruction assistance to Afghanistan. Developments in Afghanistan have an impact on Singapore's security. Several of Singapore's JI detainees received their terrorist training in Afghanistan. They were part of a terror cell plotting to carry out attacks on targets in Singapore. Terrorism operates without regard for national borders. Singapore is thus prepared to work together, within our means, with the some 40 other countries currently working in Afghanistan to build the institutions, infrastructure and services that will bring brighter prospects to the people of Afghanistan.

The SAF will be undertaking two humanitarian and reconstruction projects in Afghanistan as part of the New Zealand Provincial Reconstruction Team in Bamiyan Province in central Afghanistan. The SAF and NZDF know each other well and have previously deployed together in the UN mission in East Timor. The NZDF has operated in Bamiyan Province since 2003. Their personnel have built up a strong foundation of trust with the local community and provincial government.

For the first project, the SAF will deploy a five-man medical team to Bamiyan hospital to set up a dental clinic. The SAF team will bring specialised equipment, set up the clinic, and train local Afghans to take over the clinic on a long term basis. Separately, under the Singapore Co-operation Programme, training will also be provided to the Afghans in dentistry and basic healthcare so they can build up sustainable capabilities. For the second project, a five-man SAF combat engineering team will undertake bridge construction and repair work, together with the NZDF and local Afghan contractors. The SAF assessed these projects would be most helpful to the Afghan people after consulting the NZDF, and the Afghan Government and local Afghan authorities during a site visit. Each team will be deployed for three months. We are currently working out the details with the parties involved, including the NZDF, NATO and the Afghan Government.

Mr Chairman Sir, the Singapore Government will continue to contribute within our means to international peace support operations, as well as relief and reconstruction efforts where the SAF can usefully play a role. But the primary mission of the SAF will still be to defend Singapore. Our security is our top priority.

Third Generation SAF

Ms Indranee Rajah, Dr Ong Chit Chung, Ms Irene Ng and Mr Arthur Fong and other members asked about our priorities and the SAF's transformation efforts. On the military front, we are developing the SAF to meet the full range of potential threats to our security — from an assault on our sovereignty and territory, to dealing with low-intensity conflicts, to fighting terrorism — while simultaneously transforming the SAF for tomorrow. These are our priorities.

We continue to acquire and deploy cutting-edge weapon systems and information technology so that the SAF's operations will be characterised by speed, precision, knowledge and integration. These leverage on our strengths and allow us to overcome the constraints of our small population and size. The SAF's acquisition of advanced military hardware — such as the F-15SG, Seahawk naval helicopters, the Primus self-propelled howitzer, as well as the recently announced Leopard Tanks — replace older, less capable systems and add important new capabilities. Ms Indranee Rajah asked me to describe the elephant — well, we have leopards, we have eagles, we have sea hawks, we have humans, super ones. We have falcons, we have zebras and indeed we have elephants too and some mythical animals like the Pegasus, the winged horse, too. What we are trying to do with the Third Generation SAF is to harness the technology to draw on the capability to defend Singapore. The strength of the Third Generation SAF is not from having more platforms or specific platform capabilities alone. The strength of the Third Generation SAF is multiplied by our ability to network the various systems and capabilities, so that the overall fighting system is much more capable than the sum of the individual parts. Advanced command, control and communications, enabled by information technology and networking, now allow rapid dissemination of information, to give commanders and their subordinate units better awareness, and enable them to exercise better control and self-synchronisation in order to operate as a tightly integrated system.

In the 3rd Generation SAF, the Army, Navy and Airforce operate jointly to leverage on each other's strike and manoeuvre capabilities to achieve the mission. On land, our capability comprises a network of unmanned sensors, precision missiles delivered by Apache attack helicopters, smart bombs delivered by fighter aircraft, and armoured forces on the ground. In the air war, navy frigates play a major role because their air defence systems are as capable as the Air Force's. We can thus find a target by multiple means, attack it at multiple points and in different ways simultaneously. The sensor-to-shooter cycle is reduced to a matter of minutes between the time a target appears, is positively identified, is engaged and destroyed.

Elements within the Services have also become more tightly connected. The most recent development in the ongoing transformation of the Army into a leaner, closely networked force was the Battlefield Management System. This networked

system enables the prompt sharing of information about locations and movements of friendly and enemy forces. It is basically a computer screen - you can send SMS-type messages, see the positions of friendly forces, enemy forces. It integrates the Infantry Fighting Vehicle Bionix II with an array of platforms, including Unmanned Aerial Vehicles, the Primus Self-Propelled Howitzer and the Bronco Mortar Track Carrier. This capability provides ground manoeuvre forces the ability to increase their tempo of operations and their area of influence, and also allows Headquarters to command and control its forces more effectively. Pictures tell a thousand words and I invite members of the House to watch the DVD that has been provided to you in the little Third Generation package that has been distributed.

To sustain our technology edge, Mr Zainuddin Nordin rightly pointed out that sufficient resources and manpower need to be allocated for defence R&D. Today, we have in MINDEF, Defence Science Organisation National Laboratories and the Defence Science and Technology Agency, some 3000 engineers and scientists. We invest about 4% of our defence budget on R&D. Within Singapore, we leverage on our defence industry, research institutes and institutes of higher learning to multiply our own capabilities. We also collaborate with international R&D partners. Our ability to attract world-class partners such as DARPA - the US Defence Advanced Research Projects Agency - and the French Directorate of Armaments on win-win collaborative projects shows that our R&D effort has generated world-class technologies that renowned defence research agencies also find valuable. A good example is the combat information system on board the RSN's new Formidable class frigate. The highly complex integration work and writing of the system software was carried out by our DSO and DSTA engineers. The system integrates all the combat systems together and provides the crew of the Formidable with state-of-the-art real-time decision making tools.

Another example is our Underground Ammunition facility, which will be commissioned later this year. More than ten years ago, DSTA, together with our R&D partners in NUS, NTU, Norway, Sweden and the US, embarked on R&D in underground rock cavern design and construction. The knowledge gained from this pioneering project resulted in several benefits. It freed up scarce surface land space for other uses. The expertise built up enabled DSTA to advise other agencies such as Jurong Town Corporation on its recently announced project to build underground storage facilities for Jurong Island. The excavation for our underground facility also contributed a good supply of granite for construction.

Technology is only one dimension of our transformation efforts. We are also making significant organisation changes to ensure we are nimble and responsive in a complex and evolving operating environment. The revamp of the command structure of the RSAF announced in January this year, is the most recent example. The new structure is flatter, with greater decentralisation of decision making and lateral

communication. This reflects the more varied tasks the air force has to perform today. The establishment of the first of the five new commands, the Air Defence and Operations Command, will allow more effective management of the full spectrum of air operations. The army organisation has also be restructured. I won't go into that, there is a nice picture of that in Pioneer or Army News.

At the heart of these transformation efforts is an innovative military. We can expect potential adversaries — both state and non-state — to be agile and adaptive. We must constantly think faster and run ahead. We must be enterprising and adapt quickly. But, superior organisation and technology alone do not guarantee this. We can only achieve a sustainable edge over emerging threats by also pursuing qualitative superiority in the motivation, initiative, proficiency, and the improvisational skills of our people. One example is this year's NDP that is conducted over Marina Bay. The idea came from our Singapore Combat Engineers. They put it to us and we agreed because it is a very creative and innovative idea. We all look forward to it. As Ms Indranee Rajah pointed out, the strength of the SAF lies in the quality of our people and how well we train them. The SAF is committed to developing the full potential of all our people - NSFs, NSmen and Regulars. And how we keep our NSmen up-to-date is why we place so much importance on ICT, in-camp training. Third Generation concepts, new training methods, new weapons and systems are systematically infused into our ICT training. And our technologically savvy and highly educated population is a great advantage because our people pick up technology so quickly. The SAF will continue to invest heavily in the training of our Regular Servicemen. We will continue to send them overseas to learn, observe and bring home knowledge and experience. This will also ensure that the SAF always keeps abreast of the latest technology, operational concepts and training developments worldwide and benchmarks itself against the best in the world. We will also be enhancing the education and training opportunities for our Warrant Officers and Specialists Corps to develop further as specialists in their respective functional areas.

Ms Ng asked whether Singapore's defence expenditure is big or sufficient. It does not make sense for a small country such as Singapore to have aggressive intentions towards any other country. Our defence posture is designed to deter military interference or pressure against Singapore, and to defend ourselves if our survival or vital national interests are at stake. A capable and operationally ready SAF ensures this. Other countries in the region are also putting emphasis on defence. According to the US Congressional Research Service, from 2002 to 2005, five Asian countries were among the top ten developing country arms importers - China, India, South Korea, Malaysia and Pakistan. Singapore too needs to prepare itself to meet the eventualities that may arise from the more uncertain and complex strategic and operational environment.

Ms Ng, Mr Low asked how we ensure that the defence budget is prudently utilised. MINDEF has rigorous checks in our budget process to ensure we use the money allocated to defence prudently. Overall long-term force development plans are carefully drawn up and scrutinised in a process involving the three Services, the Joint Staff, and MINDEF's Policy, Technology and Defence Management groups. They challenge each other. Operational needs and priorities, alternative force structures, and resource implications are studied in a rigorous iterative process to arrive at a long term plan which then has to be presented to the Minister and is subject to his approval. These plans map out the overall force structure requirements and match them to resources available. That is not the end of the process.

Each individual acquisition programme has to be carefully scrutinised to determine need, evaluate options and decide on the most cost effective solutions. MINDEF's acquisition process is well respected and recognised internationally for its professionalism, thoroughness and probity. Indeed MINDEF's process for analysing the costs and benefits of competing proposals was adapted for use in the selection of our Integrated Resorts.

MINDEF is mindful of its responsibility to spend wisely, and buy equipment carefully. We only buy what we need, and what is most suitable and cost-effective for us. We buy very sophisticated and highly capable equipment, but only when it is needed. Often we don't need to buy the latest piece of equipment, when upgrading or refurbishing can do the job. When we replace older equipment with more modern ones, we often don't need to replace them on a one-for-one basis. For example, our A4 Skyhawks first came into operational service in refurbished condition in 1974. The Skyhawks subsequently underwent an engine and avionics upgrade in the late 1980s. When they retire from operational service recently, the Skyhawks had served the RSAF for 30 years. We replaced them with smaller numbers of more modern fighters. The SM1 tanks which are now being gradually retired, were bought as second-hand AMX 13 tanks from various countries in the late 1960s and refurbished. In the late 1980s they were upgraded to the SM1 standard and only now are we beginning to phase them out after over 40 years in the SAF. We have close to some 300 SM1s. We are replacing the first batch of the SM1s with the refurbished Leopard 2A4. We recently bought 66, with 30 spare tanks, from German Army stocks. We will replace the remainder in the coming years. But not on one-for-one basis as the Leopards are more capable. Certain prime equipment that the SAF uses are also refurbished, e.g. our KC 135 tankers which have been deployed several times to the Gulf are refurbished tanks from US Armed Forces. Our Challenger class submarines as well as the Vastergotland class subs we have contracted for are refurbished. The SAF also has mechanisms in place to control our operations and personnel costs very tightly. We control our operations cost by constantly seeking to streamline our orbat. To limit personnel costs, we have maintained zero growth in establishment since 1986.

We seek to extract the best value for money and maximise our defence capability from each defence dollar. Although the government has stated that as a policy, it is prepared to spend up to 6% of GDP on defence, in practice defence spending in the last five years has been kept to between 4.5% and 5% of GDP, slightly lower than the 5 to 5.4% in the previous five years. Is this defence budget sufficient? Well, the Ministry of Finance has provided MINDEF with what it has asked for. I will not hesitate to ask for more if I feel that I need it and I have confidence that I will be able to persuade my colleagues in Ministry of Finance to provide it to me if I do because there is strong commitment for defence in this country and strong support in this house. By spending smart, we will continue to preserve the SAF's edge, and with it the peace and security which provide the foundation for the progress we have enjoyed these last 40 years.

National Service

Now on National Service, we mark 40 years of National Service this year. The commitment of our 300,000 Operationally Ready National Servicemen (NSmen) has been the cornerstone of a strong SAF. We will continue to need national service for the foreseeable future as there is no other way in which we can build an SAF that is of sufficient size and capability to defend ourselves given our small population. As Mr Arthur Fong has said, we still need the numbers. Although we go for quality and try to keep numbers down, as one military observer has said, quantity has a quality all of its own.

Our NSmen play a critical role in making the SAF a credible deterrent and fighting force. Since its inception, National Service has become a national institution and a rite of passage for all Singaporean men. More than 700,000 Singaporeans have served or are serving National Service. Their common experience during National Service has helped forge robust bonds, a strong national identity, and importantly, the collective will to defend ourselves. In a survey of NSmen conducted last year, an overwhelming majority of NSmen indicated that they will defend Singapore if it should come under threat, and that they will risk their lives to fight for Singapore in a war. We also have about 360 NSmen who have volunteered to extend their operationally ready NS. One of them is LTC(NS) See Tow Pak Onn, an NSman for more than twenty years and he voluntarily extended his ORNS commitments for close to six years to date. He will be the NDP commander for this year. We are thankful to have dedicated NSmen like Pak Onn in the SAF.

Investment in Defence

Our investments in technology, systems and people in defence are our investment in a secure future, and they have paid off.

I was gratified to read the recent series of forum page letters to the Straits Times on defence spending. They show that many Singaporeans understand the need for a strong defence. Xiao Fuchun wrote in the 30 Jan edition that Singapore's "tiny size makes it a tempting target and only a strong SAF keeps potential aggressors in check. Such a capability does not come free". And Lu Junwen framed the issue well when he wrote that "our armed forces have taken away aggression as a viable option of political intercourse with Singapore… having a capable defence force means its leaders can sit at the negotiating table and expect a fair negotiation session, instead of having conditions dictated to them by their counterparts". He added, "one cannot expect to have a capable military on call when one does not continually invest in its capabilities" because "military capabilities, once sacrificed as a result of funding cuts, can take an inordinate amount of time to restore".

It is for these reasons that we are prepared to invest steadily in defence. This enables Singapore to have a credible military built around a relatively small standing force of conscripts and career soldiers, and a much larger force of NSmen who are well-trained, experienced and available on short notice. It also ensures we have the means to train and equip our NSmen in the best possible way, so that if they have to fight, they will win and they will come home safely. These investments ensure that we and our families can live our lives in peace and security and determine our own future.