Addressing Energy as a Military Cost
Dr Jennifer L. Palmer, DSTO

Identifying, Measuring and Mitigating Risk in Theatre-Strategic and Operational Planning
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The Pen and the Sword
L. Rees, DSTO, Captain D. Lush, Australian Army and Major B. Stanton, Australian Army

Organisational Efficiency and Effectiveness: Lessons from Computing Theory
Dr Richard Taylor, DSTO

Objective Soraken Peninsula
Mervyn Hill

Department of Veterans’ Affairs 2008 Veteran Community Story Writing and Art Competition – Winner of the ‘True War Experience’ Australian Defence Force Journal prize
GUIDANCE FOR AUTHORS

The Australian Defence Force Journal seeks articles on a wide range of defence and security matters such as Strategic Studies, Security and International Relations. Normally, articles will only be considered for publication if they are current and have not been published elsewhere. In addition, the journal does not pay for articles, but a $500 prize is awarded by the Board of Management for the article judged to be the best per edition.

The Layout

Articles need to be submitted electronically and typed in MS Word format without paragraph numbers (essay style). Headings throughout are acceptable. Length should be between 3,500 and 5,500 words (which allows a spread of articles per journal). Please spell check the document with Australian English before sending.

Articles can contain endnotes, bibliography and brief biography.

Endnotes are required in the style:


References or Bibliography in the style:


Tables, maps and photographs are also acceptable, but must be of high enough quality to reproduce. Photographs must be at least 300 ppi in TIF format and be directly pertinent to the article.

The Review Process

Once an article is submitted, it is reviewed by an independent referee with some knowledge of the subject. Comments from the reviewer are passed via the Managing Editor to the author. Once updated, the article is presented to the Australian Defence Force Journal Board of Management and if accepted, will be published in the next Journal. Be advised, it may take quite a while from submission to print.

Authors with suitable articles are invited to contact the Managing Editor via Internet email at: <publications@defence.adc.edu.au>.

Authors accept the Editor may choose to make minor editorial adjustments without reference back to the author. The theme or intent of the article will not be changed.
CONTENTS

CHAIRMAN’S COMMENTS 2

LETTERS TO THE EDITOR 3

Addressing Energy as a Military Cost 6
Dr Jennifer L. Palmer, DSTO

Identifying, Measuring and Mitigating Risk in Theatre-Strategic and Operational Planning 32
Commander Stephen P. Ferris, SC, USN

The Pen and the Sword 48
L. Rees, DSTO, Captain D. Lush, Australian Army and Major B. Stanton, Australian Army

Organisational Efficiency and Effectiveness: Lessons from Computing Theory 68
Dr Richard Taylor, DSTO

Objective Soraken Peninsula 80
Mervyn Hill
Department of Veterans’ Affairs 2008 Veteran Community Story Writing and Art Competition – Winner of the ‘True War Experience’
Australian Defence Force Journal prize

BOOK REVIEWS 85
Welcome to *Australian Defence Force Journal* Issue No. 178. This issue covers a variety of topics including Dr Jennifer Palmer’s article ‘Addressing Energy as a Military Cost’ in which she postulates that the energy requirements for military platforms will likely become a key driver of future technology selection by the Australian Defence Force. In the article by authors Leanne Rees, Captain Lush and Major Stanton, some insight is given into how to successfully field a military adviser/civilian analyst team; these teams play a vital role in providing analytical support to commanders in the field. Commander Ferris from the United States Navy looks at identifying, mastering and mitigating risk in theatre-strategic and operational planning and, in his article, Dr Richard Taylor suggests that computational modelling may be the tool to better understand the performance of organisational models, exploring, in a fundamental sense, the ability to measure such model performance.

It gives me great pleasure to include the article by Mervyn Hill and to congratulate him on winning the Australian Defence Force Journal Prize for 2008. The prize is awarded to the wartime experience story judged best by the judging committee of the Department of Veterans’ Affairs annual Story Writing and Art competition. The Australian Defence Force Journal Board of Management has been involved with this worthwhile project for many years with the aim of encouraging the veterans community to write of their wartime experiences and to share them with present and future Service personnel.

I am pleased to announce that Dr Jennifer Palmer with her article ‘Addressing Energy as a Military Cost’ has been chosen to receive the $500 prize for best article.

I hope you enjoy reading this issue of the *Journal*.

James Goldrick,
Rear Admiral, RAN
Commander, Joint Education, Training and Warfare Command
Chairman of the Australian Defence Force Journal Board
Letters to the Editor

Dear Editor,

Darwin 1942

In accordance with our telephone conversation I am forwarding comments on an article included in your Journal No. 122 of Jan/Feb 1997.

The delay in time is regretted but the Journal has only recently been forwarded to me. The standard of your Journal is unknown but reading it, noting the rules of engagement and its presentation I gained a feeling of reality.

Pages 38 to 77 contain an article by the late Air Commodore A.D. Garrison who is described as having been a valued officer of the RAAF. He was a member of the Military Historical Society of Australia, the Royal Aeronautical Society and the Royal United Services Institute.

Considering the history of the writer and the aura of the Journal readers could be pardoned for taking the contents as history, however, the article contains a number of errors which I think it important to correct.

I was a member of the 14th Heavy Anti-Aircraft Battery stationed as a Bombardier at the Oval on the Esplanade. The unit arrived in Darwin in December 1940 and was trained on 76 mm (3 inch) guns and 94 mm (3.7 inch) guns. In their spare time they worked with the 2/3rd and 2/4th Pioneer Battalions installing twelve 94 mm fixed A/A guns. We manned the guns in the defence of Darwin against the ferocious assaults of the Japanese.

The following comments are made as seen by a gunner who is well prepared to apologise if I am in error.

1. Appendix A – List of Army units 19th February 1942

Omitted from the list is the 2nd and 14th Heavy A/A Batteries. The two batteries were the only A/A defence in Darwin until late March 1942 when some USA fighters, P40s, arrived. Included in the list is the 2/14th Pioneer Battalion. It is believed that should be the 2/4th Pioneer Battalion. 1/54th A/A Company – its existence is queried. The number of the Company seems incorrect. The 1/54 A/Searchlight Coy may have been the 54 A/A Searchlight Coy.

2. Appendix D – Allied Casualties

The crew of the Neptuna is listed as a number of 125. It is believed to be less than that. It is understood that 11 officers and about 25 crew were killed. It mentions that 45 crew of Peary died. I may be wrong but thought the casualties nearer 80.
3. **Page 47 – right column – para 3.**

The complete Army Order of Battle is set out in Appendix A and includes two USA artillery units which had been disembarked only the day before. It is known from *Merchant Men of WWII* that members of the USA 148th Field Artillery Battalion were still on board the *Tulagi*.  

4. **Page 47 – right column – para 5**

There were no A/A weapons at the civil aerodrome or Bachelor – The four mobile 76mm guns in mothballs were transferred to Bachelor in December 1941.

Para 2 speaks of machine guns being stationed around Darwin. They were few and far between. Only one Lewis gun was provided for each A/A section. There were five Lewis guns of the 14th on top of the oil tanks.

Para 5 - there were some machine guns with the RAAF but I am not sure they had crews because officers manned the guns.

5. **Page 52 – right column – para 4**

The writer makes some false statements here and omits other relevant information. The last sentence of the para shows no confidence in the Army’s ability to identify planes. Identification was a main subject in our training as was proved by the A/A going into action before the general alarm was made. It is not mentioned that friendly planes had a designated approach route and signals, none of which were used. Even though they may have been under pressure they could have lowered their wheels. The lack of communications was common and late in ‘41 or early ‘42 the Oval fired a warning shot for the same reason. The words that the A/A ‘engaged’ the bombers was definitely wrong. When a section of the A/A ‘engaged’ a target it fired a salvo from its four 94mm guns. That is all followed by remarks that there was no damage or casualties.

The A/A knew they were Lockheed Hudsons but were not sure as to who were crewing them.

The writer makes a blanket charge on looting and complains that the Army commanders did not control the troops. I am not aware of the troops’ general behaviour but I know in the A/A we were confined to a close proximity to the guns for the next six months.

6. **Page 53**

In other parts of the article the writer says that an Army officer warned the A/A that enemy planes were approaching. That is not true. One section of A/A were training on the Japanese as they approached. Our alarm at the Oval heard chatter on the phone and sounded the alarm.

7. **Defenders**

Under this heading is listed 53 planes. There were 10 P40s and 43 non-combatants including a Puss Moth.
8. **General**

I am not sure the exact time of the raid but 9.58 is used at random. I do know that the A/A at the Oval were in action before any general warnings were given. There are comments that the raids were expected and yet Air Chief Marshal Sir F. Scherger was of the opinion that Darwin would not be attacked. It is wondered what effect the opinion of the senior RAAF’s man had on RAAF members.

There are other matters, which could be queried but I feel that this is enough.

I have written a book entitled *Darwin Bombed*, an autobiography of my time with the 14th in Darwin. If anyone is interested I would be happy to forward a copy. The book was well received by the Royal Australian Historical Society and other people.

Jack Mulholland
Wyoming, NSW
Addressing Energy as a Military Cost

Dr Jennifer L. Palmer, DSTO

Energy realities and military consequences

The reduction of conventional energy requirements for military platforms will likely become a key driver of future technology selection by the Australian Defence Force (ADF) and allied militaries, due to shifting public opinion about environmental issues, changing government policy, and the escalating price and shrinking global supply of oil. The strategic necessity for addressing this issue within the ADF has been examined in detail by White (The Australian Defence Force Journal, No. 175, 2008); whereas the current article focuses on the tactical aspects of energy usage. Here, the concept of a military cost function for energy that includes the various monetary and non-monetary costs of energy for military use is introduced. It will be demonstrated that the challenges to the ADF’s current usage of energy present myriad opportunities, because reducing the military costs of energy, including monetary expenditures and energy-related risks, can increase capability and effectiveness, as well as helping to maintain our regional strategic superiority. Research efforts underway globally address the fundamental objective of reducing force signature and thus military risk by minimising logistical requirements and the thermal and acoustic signatures created by traditional combustion engines and electrical generators. Mitigation of these risks is among the primary benefits of addressing energy as a military cost.

The ‘costs’ of energy

In economics and accounting, the cost of an asset or system is the sum of the direct and indirect monetary expenditures for its acquisition, maintenance and retention, often referred to as the ‘total cost of ownership’. The concept may be broadened to encompass a range of monetary and non-monetary costs, each of which may be assigned a weight representing its relative importance in a given scenario. The sum of the products of the individual weighting coefficients and costs then yields a ‘cost function’ that is minimised to achieve the best performance within the constraints imposed. This approach may be used to define military costs, such as those related to the energy necessary to operate and sustain air, sea, ground and human systems. It differs from the concept of total cost of ownership in that the commodity under consideration is an on-going expense or operational requirement, rather than a single asset or class of assets, and the ‘costs’ are not purely monetary. The term military cost will be used here to refer to any of the monetary or non-monetary components of the cost function and the term military cost function will be used to refer to a weighted sum of the various military costs, also referred to as the total military cost.

The true cost of the energy supplied to military platforms encompasses both direct and indirect monetary expenses and non-monetary or intangible ‘costs’ that result from risks associated with energy supply and usage and from the accompanying environmental and social effects.
The monetary costs include not only the price of energy purchases and direct logistical and operational expenses, but also geopolitical risks and costs associated with maintaining reliable global energy supplies. Greenhouse-gas emissions and pollution from the use of hydrocarbon fuels have or soon will have not only a monetary cost, but also non-monetary social, political and environmental costs that may result in future military expenditure. Risks incurred by the use of manpower and equipment for logistical and other missions related to energy, military risks due to signatures of various kinds, and the risk of capability degradation resulting from spending on fuels and fuel-logistics, etc., rather than on enhancements, must be considered. Furthermore, should anticipated changes in international energy markets precede the planned withdrawal date of platforms purchased in the current oil-dependent period, their premature replacement will lead to unforeseen expenditures. Each of these risks represents a statistically probable element of the military cost function, related to the consequence of mission failure or the loss of personnel or materiel due to the requirement for energy to power military platforms.

**Weighting of ‘cost’ elements**

The weights assigned to the elements of the military cost function for energy differ for various missions. For example, for peacetime force maintenance, the weight given to the direct and strategic or geopolitical costs of energy supplies may be significantly higher than that assigned to the acoustic and radiative (i.e. thermal) signatures produced by the use of hydrocarbon fuels in generators, vehicle propulsion systems, etc. Similarly, costs associated with supply and force-protection operations may be minimised simply by the stability of the situation and the location of the forces (e.g. on home soil or in semi-permanent bases) and the identification of force location caused by any logistical ‘signature’ may be irrelevant, and thus the military cost of that risk assigned a low weight.

In contrast, in a covert operation by Special Forces, the monetary expenditure associated with providing energy supplies (e.g. batteries) may be negligible, while the cost to the individual warrior of accessing and carrying energy supplies may be quite high, indeed life-threatening, and may endanger the entire mission. In these circumstances, the use of one energy source may be preferred over another because of the risks associated with each and a reduction of the military cost function for energy may be achieved through proper selection. For example, battery or fuel-cell powered motors on air and ground vehicles are more desirable than conventionally fuelled internal combustion engines, if covertness is to be maintained. Although the monetary cost of the energy supplies and the vehicles themselves may not be decreased and may in fact increase as a result, military costs associated with personnel, equipment, and mission risks may decrease, while capability and mission robustness may increase, hence the military cost function for energy may be minimised. Regardless of the type of energy utilised, the ultimate goal for Special Forces, as envisioned by the US Defense Advanced Research Projects Agency (DARPA), is the achievement of ‘tactical energy independence’ or, as demonstrated here, the minimisation of the military cost function for energy under the constraints imposed by the operation.

In the conduct of war, emphasis is placed on elements of the military cost function that when decreased lead to increased mission reach, rapidity, and robustness. For instance, the monetary
costs associated with energy purchases and logistics may be reduced if a remotely operating force utilises efficiency, environmental harvesting, recycling and novel sources to become more self-sufficient, much as insurgent forces 'live off the land'. Perhaps more importantly, this also decreases the risk exposure of personnel and assets involved in supply operations and those receiving the energy supplies as well as the risk to missions, decreasing political and social costs by reducing casualties, increasing the likelihood of mission success, and thereby increasing force effectiveness and survivability.

Alternative energy for military installations and deployed forces

The US Government has recently confronted rising petroleum prices and belatedly recognised the West's vulnerability and the geopolitical and military costs associated with energy, including that used by military forces. Various projects aimed at reducing the petroleum-based energy required for military missions through increasing efficiency and extracting energy from alternative sources have been undertaken to address the direct costs to the military. These efforts aim to reduce the enormous direct expense and logistical load associated with supplying the 9 million litres of diesel fuel used daily by US forces in Afghanistan and Iraq, as well as other global commitments. They also serve as models for civilian and commercial alternative power generation and have obvious social and environmental benefits.

Large-scale environmental energy harvesting is being employed in the form of wind, solar, and geothermal power for electricity generation on military bases (see Figure 1a and b for examples) and its use is expected to increase dramatically at stationary bases in the future, as it will in the civilian sector. One novel technology, termed ocean thermal-energy conversion (OTEC), is being explored by the US military for use on remote island bases. Because OTEC relies on the temperature difference between shallow and deep oceanic strata, it can dramatically cut the cost and improve the reliability of electrical supplies, while largely eliminating the logistical load for fuel. It is anticipated that OTEC plants will soon replace diesel-fuelled generators on US military bases on the island of Diego Garcia and on Kwajalein Island and may serve as their sole source of electrical power and provide desalinated water.

Hybrid generators relying on solar, wind, battery and diesel power have also been proposed for military use and, in mid 2006, were the subject of an urgent request by a senior US commander in the Middle East to reduce the casualties associated with logistical operations and to allow the refocusing of forces away from fuel carriage, which comprises about 70 per cent of the bulk haulage in-theatre. To meet this requirement, a containerised Mobile Power Station has been proven in the field and deployed to bases in the US for further trial (see Figure 1c). Although small hybrid power stations are not inexpensive, costing up to US$100,000 for a 10-kW unit, their price compares not unfavourably with that of a year's worth of fuel for a diesel generator, estimated to be US$36,000, including logistical and force-protection expenses, which, along with the accompanying casualties, are the most significant military costs associated with energy supplies for deployed forces. Hybrid generators can cut operating costs by a factor of 4, repaying their purchase price in three to five years, as well as reducing the military costs of thermal signatures and increasing the mobility and self-sustainability of forward operating bases.
Similar goals are being pursued under a six-year US Army program announced in 2007 that aims to develop a Hybrid Intelligent Power (HI-Power) System for electrical distribution and control at forward operating bases. The system will provide backup for traditional and hybrid electrical generators and switch amongst all available sources of generation and storage in a localised grid, maximising efficiency and minimising disruptions. It is expected that fuel consumption for field bases will be halved when the technology is implemented.

**Figure 1:** a) Photovoltaic panels at Nellis Air Force Base, NV, USA, providing 25 per cent of the power needs for the 12,000 people living and working at the largest advanced air-combat training facility in the world. Photograph courtesy of SunPower Corp. © 2007. Reproduced with permission. b) Two of the 80-m tall wind turbines at the US Naval Station at Guantanamo Bay, Cuba, part of a set of 4 delivering up to 25 per cent of the energy needs of the base. Photograph by Kathleen T. Rhem, 2005; provided by the American Forces Press Service. Reproduced with permission. c) A containerised, hybrid Mobile Power Station or Transportable Hybrid Electric Power Station, designed for the US Army. Photograph provided by SkyBuilt Power © 2004. Reproduced with permission. d) A Tactical Garbage-to-Energy Refinery or ‘biorefinery’ designed to convert battlefield refuse (e.g. food waste, paper, and plastic) into liquid fuels, under trial at the US Army forward operating base, Victory Base Camp, Iraq, in mid 2008. Photograph provided by Tom Campbell © 2007. Reproduced with permission.
DARPA identified packaging materials and other refuse as a potential source of battlefield fuel and began the Mobile Integrated Sustainable Energy Recovery program to explore the concept in 2003, with the goal of reducing a forward operating force’s ‘unit signature’ (i.e. waste stream) as well as the logistical load involved not only in fuel delivery, but also in waste disposal. The project was motivated by the fact that the average deployed US soldier produces 3kg of packaging waste per day, predominantly plastic materials with an energy-content comparable to that of diesel fuel, which, if recycled, could make units energy-independent. The results of the program include the development of a ‘tactical biorefinery,’ capable of converting food waste into ethanol, and paper, cardboard, plastic and Styrofoam into a liquid fuel similar to low-grade propane. Pictured in Figure 1d is a biorefinery unit that was trialled by US Army forces at Victory Base Camp, Iraq, in 2008. In parallel, a tough and durable bioplastic material made from agricultural products was developed that could replace the packaging used for military supplies to yield a yet more efficient and environmentally sustainable process.

Approaches for mobile military platforms

In contrast with the macro- or meso-scale applications described above, environmental energy harvesting and the use of novel energy sources by mobile military platforms (i.e. ground, air and sea vehicles and individual personnel) have to date been pursued largely through research, however, the benefits of reducing the military cost of energy for these systems are just as profound. The efforts with the most pervasive effects and greatest monetary cost savings have the goal of reducing the use of conventional liquid propellants, such as diesel and jet fuels. The US Air Force and global airline manufacturers are currently exploring the use of synthetic- and bio-fuel blends for military and civilian aircraft. Because more than half of the fuel used by US military forces powers aircraft, this could substantially reduce the reliance of US and allied militaries on petroleum-based products from the Middle East and other unstable parts of the globe and lessen the geopolitical and logistical components of the total military cost of their energy requirements. The Integrated Vehicle Energy Technology Demonstration (INVENT) and Adaptive Versatile Engine Technology (ADVENT) programs, recently initiated by the US Air Force Research Laboratory, aim to conserve fuel on aircraft through the reduction of waste-heat production and engine design that optimises performance over a range of speed and altitude, respectively. Fuel-efficient aero-engines are also the focus of current European research and technology demonstrations.

An obvious extension of civilian automotive technology is the use of hybrid power for military ground vehicles. Tactical trucks and combat vehicles with hybrid powertrains consisting of diesel engines, electric motors and energy storage units (i.e. batteries, fuel cells or capacitors) have been produced in small numbers for the US Army (see Figure 2 for examples). The vehicles are quiet and fuel-efficient and may produce enough electrical power to eliminate the need for a separate towed generator for applications such as small airfields, medical facilities, field kitchens, military command centres, and mobile radar and weapons systems. Stealthy, purely electrical operation is an attractive option with these vehicles, though they have yet to be deployed because of the perceived immaturity of the technology. In addition, ships and submarines powered by hybrid systems consisting of diesel engines, fuel cells and batteries have been proven by German naval architects and deployed by several European and
Asian navies, although it would appear that nuclear power will continue to be preferred for maritime propulsion by the US Navy and its expansion to reduce the use of petroleum-based fuels is likely.

Energy harvesting, scavenging and recycling for mobile platforms

Energy scavenging and recycling are also being pursued to more fully utilise the fuel consumed for propulsion by aircraft, ships and ground vehicles and to harness the energy expended by human locomotion. These techniques (a complete, though not exhaustive range of which is shown in Figure 3) rely not on the ambient environment in which a system operates, but rather on conditions created by the platform itself, hence their designation as recycling or scavenging, rather than environmental energy harvesting. One example of scavenging is the collection of energy from the vibrations and strains induced in the structure of a vehicle as it moves through air or water or over terrain, or as wind or water flows around a remote sensor. The imparted kinetic or strain energy may be captured by use of piezoelectric materials or by other means to generate electrical power. Systems have been designed to harness the energy imparted to an aero-structure by mechanical vibrations and thus to damp those vibrations, reducing fatigue ageing, and to power micro-electromechanical system (MEMS) sensors for external or internal (i.e. vehicle health and usage) monitoring. Large numbers of these sensors are envisioned for use in the skin and structure of future aircraft, but, without being self-powered, they would be unusable because of the complexity and prohibitive weight of the wiring required to power them. These technologies enable greater military capability and sustainability, while reducing direct maintenance and logistical expenses and driving down several components of the military cost of energy.
Advances in many of the small-scale energy scavenging technologies have been made because of the desire to eliminate or to supplement the batteries in personal electronic devices.\textsuperscript{44} Batteries, including spares, for the various devices carried by modern soldiers (e.g. communications and navigation equipment, cameras, weapon sights, night-vision goggles, and laptop computers) contribute significantly to their increasingly heavy loads, affecting their mobility and increasing the risk and resultant \textit{military costs} of casualties and mission failure.\textsuperscript{45} Indeed, 20kg of spent lithium batteries are typically discarded by a single soldier during a five-week deployment\textsuperscript{46} and up to 88 AA-cell primary batteries may be consumed on a five-day mission.\textsuperscript{47} To address this, the Australian Department of Defence has undertaken several Capability and Technology Demonstrator (CTD) projects on wearable power management and energy harvesting technologies.\textsuperscript{48} These efforts have the goal of reducing the number and number of types of batteries soldiers carry, the expense and logistical burden of their supply, and the need to recharge with different systems and eventually to dispose of large quantities of toxic and potentially explosive batteries.

The central element of these projects is the ‘Smart Power Management System’ from Tectonica Australia, a device with a single battery, rechargeable from a variety of sources, including units worn by other soldiers, wearable energy-harvesting devices, vehicle electrical systems, fuel-cells, and external batteries, and capable of distributing and balancing power to the various electronic devices carried by the soldier.\textsuperscript{49} In 2008, the US Army contracted for a soldier-borne power management system\textsuperscript{50} and the US Department of Defense awarded a substantial prize for the creation of a device required to provide sufficient electrical power (i.e. 20 W) for the typical soldier’s portable electronics for 96 hours and to have a mass of no more than 4 kg, less than half that of their current batteries.\textsuperscript{51}
A complementary power-generation device that can be built into body armour to convert kinetic energy from the wearer’s movement into electricity is shown in Figure 4a. It was proposed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and selected for the Australian Defence CTD Program in 2007. Similar efforts exploring the use of vibrational energy scavenging on military clothing and footwear and for remote sensors are underway internationally.

The Smart Power Management System and other field power supplies may also be recharged with solar energy or even body heat. Figure 4b illustrates one use of a flexible, camouflaged solar-collection material that utilises dye-based artificial photosynthesis to convert solar radiation into electrical power. It was developed under a CTD project initiated in 2005 and is envisioned for use as shown in Figure 4b, in a battery charger built into infantry backpacks, and on mobile shelters. An alternative solar-cell material received CTD funding in mid 2008, with the aim of demonstrating the manufacture of efficient, flexible solar cells that may be incorporated into textiles while, under the ‘Soldier of the Future’ program for the US Army, testing has begun on a polymer-based solar collection material for battery chargers and camouflaged textiles designed for Special Forces units. The material, a strip of which is pictured in Figure 4c, is created inexpensively by coating nanomaterials onto rolls of plastic using traditional printing technology. Compact hydrogen fuel cells and advanced battery technologies, under development in the US, UK and Europe, also hold promise for efficiently powering portable systems for infantrymen and airmen, while efforts to develop microturbine-generators have been less successful, because of inherent inefficiencies of combustion at small scales.

Figure 4: a) An artist’s impression of the Flexible Integrated Energy Device, comprising vibration-energy-harvesting devices (VEHDs) and flexible battery material fixed onto body armour for use by infantry. Graphics provided by CSIRO © 2007. Reproduced with permission. b) An artist’s impression of how a lightweight, foldable Stealthcell Charger may be used to recharge batteries with solar power in the field. Graphic provided by Dyesol Ltd. © 2007. Reproduced with permission. c) Power Plastic®, a traditionally printed solar-collection material used by the US Army in portable battery chargers. Photograph provided by Konarka Technologies, Inc. © 2008. Reproduced with permission.
Environmental energy harvesting and novel energy sources for unmanned air vehicles

For unmanned aerial vehicles (UAVs), additional flight cycles necessary for battery replacement or re-fuelling significantly increase the risk (and subsequent cost) of loss through launches, recoveries and handling by ground personnel. Indeed, the primary reason that humans interact physically with unmanned systems is the restricted ability of vehicles or sensors to store energy. The resultant limited endurance of UAVs also creates risks to personnel through increased fuel, battery, and vehicle handling and potentially by revealing force location when vehicles take-off and land repeatedly. Furthermore, vehicles powered by internal combustion engines produce acoustic and radiative signatures that can jeopardise the vehicle, its operators or the troops it supports with intelligence, surveillance, target acquisition and reconnaissance (ISTAR). Conservation of on-board energy supplies enables greater endurance and range or allows additional payload to be carried; while the elimination of internal combustion engines on UAVs through the substitution of electrically powered motors greatly reduces their acoustic and thermal signatures, reducing the risk to troops on the ground utilising them and thereby reducing elements of the military cost of energy.

Research on the use of solar harvesting for electrical power generation directly for propulsion or for battery augmentation or fuel-cell regeneration on high-altitude, long-endurance (HALE) UAVs has been conducted by several governmental, commercial and academic organisations. In contrast with the only currently deployed HALE UAV, the Northrop Grumman Global Hawk, with a maximum endurance of 35 hours, the goal of these efforts is endurance measured in weeks, months or years. Applications of ultra-long-endurance air vehicles include, but are not limited to ISTAR, communications relay, environmental monitoring, and planetary exploration. Early research in this field was conducted by the US National Aeronautics and Space Administration (NASA) and AeroVironment through the Pathfinder and Helios programs, which resulted in lightweight UAVs with large, flexible wings covered by photovoltaic cells (see Figure 5a). A similar vehicle, the 16-m-wingspan QinetiQ prototype Zephyr, achieved an endurance record of over 83 hours in mid 2008 by flying with solar power during daylight hours and battery power at night. One recent design, funded by the US Air Force and illustrated in Figure 5b, aims to use solar energy to produce hydrogen for power generation and buoyancy and is expected to be produced as a prototype by 2011. Other HALE vehicle designs with more traditional airframes use on-board hydrogen in fuel cells or internal combustion engines, because of its high specific energy and the commensurate increase in endurance it may provide.

Environmental energy harvesting and hybrid power management are also targeted as enabling technologies by the Very-high-altitude, Ultra-endurance, Loitering Theater Unmanned Reconnaissance Element (VULTURE) program initiated by DARPA in mid 2007. The development of technologies that will permit a UAV to remain on-station in the stratosphere with a 450-kg, 5-kW payload for five years is sought. One of the successful candidates for the initial concept definition phase of the program, announced in mid 2008, is based on Zephyr and shown in Figure 5c. Another is a modular, re-configurable, solar-powered vehicle called Odysseus, shown in Figure 5d. Subscale versions of the designs selected for the next phase of the program will undergo uninterrupted three-month flights and a full-scale demonstrator is expected to fly for 12 months by 2012.
With its large landmass and relatively small population, air vehicles of this sort could serve Australia well not only in military campaigns abroad, but also by enabling surveillance and monitoring of our coastline and vast interior. The long endurance and range of these UAVs would reduce the need for air bases in remote locations for missions such as Broad Area Maritime Surveillance (BAMS) and the associated logistical expense. Greater autonomy as well as on-board image processing could further reduce the burden on and expense of ground personnel by permitting their notification only if unusual activity is observed.

Air vehicles may also soar, as birds do, on thermal updrafts or through shear layers in the atmospheric boundary layer, gaining potential energy (i.e. increased altitude, as illustrated in Figure 6) or kinetic energy (i.e. increased speed), while conserving on-board stores. This has the potential to increase the range and endurance of an electrically powered UAV by up to a factor of ten, as shown by a recent study on the feasibility of autonomous soaring of UAVs.
for military applications. Furthermore, wind-milling in updrafts may allow an air vehicle to maintain altitude while using a reversed-pitch propeller to turn a generator, running avionics and payload systems and recharging batteries or regenerating fuel cells.

UAVs have been flown to demonstrate the use of autonomous thermal soaring to achieve unpowered flight, during which solar energy was collected and stored in batteries for night-time use. This method of on-board energy conservation is well suited to small and mini-UAVs, as these vehicles fly at suitable altitudes (i.e. <3000 m) and may spend a significant fraction of their time loitering over an area of interest or waiting to be called into service. Currently, small, tactical UAVs achieve 10–15-hours endurance with conventional, high-specific energy fuels and internal combustion engines. The use of electrical power on these vehicles with battery or fuel-cell augmentation through solar collection and conservation through soaring would greatly reduce their acoustic and thermal signatures, reducing the risk to troops on the ground operating and utilising them. Furthermore, these technologies enable and are enabled by autonomy because of their ability to extend endurance and the power management strategies needed for their employment, inherently reducing the total military cost of energy.

Other forms of biomimicry and advanced materials for air vehicles

Greater energy efficiency, covertness and capability may also be obtained through the use of platforms that mimic biological systems in other ways, as they are typically leaner users of energy than their man-made equivalents and may provide guidance and inspiration for aircraft
For example, the power required for flapping-wing bird flight is only $\sim 3/4$ of the propulsive power at cruise conditions required for a scaled-down conventional aircraft or for a fixed-wing micro air vehicle (MAV) of the same mass (noting that a MAV is usually defined as a vehicle fitting into a 150-mm-diameter sphere). Steady flapping flight and intermittent modes exhibited by birds, such as bounding flight, may serve as models for the creation of small air vehicles capable of being carried by individual soldiers and conducting close-range surveillance and reconnaissance with rapid transit speed and short-duration hovering capability. Small air vehicles that mimic or are inspired by biology (i.e. exhibit biomimicry or biomorphism, respectively) are shown in Figure 7.

Challenges remain for the development of militarily useful MAVs, although recent tests of small fixed-wings UAVs powered by hydrogen fuel-cells have demonstrated significantly extended range and endurance over that of battery-powered versions, and future flights of 16-hours duration are anticipated.

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Biomorphism may be employed advantageously by larger air vehicles as well. Following the model set by birds, fish and marine mammals, wing morphology may be altered during flight. Subtle changes in wing camber, twist, sweep and leading- or trailing-edge profile may be used for control; while radical changes in wing shape and area may adapt an aircraft for efficiency in regimes varying from high subsonic or supersonic cruising to low-turning-radius manoeuvring to loitering at low speed. This may permit a single vehicle to perform a variety of military roles, streamlining training, logistical and operational requirements and potentially reducing monetary costs while increasing force flexibility and reach and decreasing logistical and risk-related military costs. In 2000, NASA initiated a morphing-aircraft research program, the main design concept of which is illustrated in Figure 8a. Advanced materials and smart
structures have been the focus of this research and that conducted by other organisations in
the US and elsewhere. For example, a sub-scale demonstrator of a folding-wing, seamless-
skin morphing aircraft, shown schematically in Figure 8d, was wind-tunnel tested up to Mach
0.9 by Lockheed Martin in 2005 as part of DARPA’s Morphing Aircraft Structures program.109
Ground and flight tests of several small morphing-wing UAVs have also been conducted
recently,110 including one intended for urban ISTAR missions,111 in which a high degree of
vehicle manoeuvrability is crucial to negotiate confined spaces and to combat the effects of
wind gust in urban canyons.112

Advanced materials are required for morphing vehicles and have been explored as well for
applications aimed at reducing the parasitic mass of air vehicles, which includes structural
mass and battery and fuel packaging. Autophagous (i.e. self-consuming) materials may provide
fuel and structure,113 lowering vehicle mass and enabling greater endurance. Multifunctional
vehicle skins composed of battery material114 have been demonstrated on small UAVs with
similar goals, and the inclusion of waste-heat scavenging115 or high-capacity energy-storage
devices116 and conformal radar arrays117 in load-bearing skin materials has been proposed.

Another potentially beneficial strategy exhibited in nature is formation flight, which can
increase the range of an individual bird by up to 70 per cent.118 Formation flight by UAVs, which
replicates the V-shape of migrating birds, has been proposed for use during long-endurance
missions.119 In this way, several inherently more reliable small vehicles may be substituted
for a single, large fragile vehicle (e.g. one similar to the Helios prototype shown in Figure
5a) to achieve the high-aspect-ratio wing profile desirable for HALE operation. Coupled with
solar-energy collection, this technique may enable extended endurance for UAVs, although
the required close flight formation presents significant control challenges.120

Conclusion

Energy sources and supplies are critical factors for any modern, mobile military force and
reducing the costs and risks associated with energy can make an important contribution to
capability and effectiveness. Efficient usage, novel sources and environmental extraction of
energy can drive down military costs by conserving, supplementing or replacing traditional
supplies, thereby permitting forces to disconnect from logistical support, to engage in
dispersed, prolonged operations, and to reserve high-specific energy sources for urgent actions.
Sources of energy available in the ambient environment or for recycling include: kinetic and
strain energy from wind, water flows and mechanical vibrations; solar and other forms of
electromagnetic radiation; thermal stratification in the Earth’s atmosphere, crust and oceans;
refuse. Applications of energy harvesting and scavenging on a variety of mobile
platforms, including unmanned systems, are under study in Australia and internationally, with
the US and Europe conducting military trials of several of the technologies. As illustrated
by the developments described here, these technologies, combined with advanced energy-
management strategies, can result not only in monetary cost savings, but also in non-monetary
savings from capability enhancements as well as geopolitical and military risk mitigation.
Political and social forces will increase the adoption of these systems for military use, and
advances made in the civilian sector and by allied militaries will benefit the ADF.
Acknowledgements

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NOTES


28


88. ibid.


30


Identifying, Measuring and Mitigating Risk in Theatre-Strategic and Operational Planning

Commander Stephen P. Ferris, SC, USN

There is no ‘perfect’ strategic decision. One always has to pay a price. One always has to balance conflicting objectives, conflicting opinions and conflicting priorities. The best strategic decision is only an approximation—and a risk.

Peter Drucker, Management analyst, scholar and author

Introduction

Risk underlies the security strategies of all nations and, according to Peter Bernstein, an economic and risk analyst, defines the boundary between the ancient and modern worlds since it introduces ‘the notion that the future is more than the whim of the gods and that men and women are not passive before nature’.1 Unfortunately, however, the concept of risk in national security strategy has been only imperfectly developed. The objective of this article is to examine more fully the idea of strategic risk as originally described by US Army War College strategist, Colonel (Retd.) Arthur Lykke, and to make it operational for modern planners attempting to design future theatre security strategies.

Lykke introduces his concept of strategic risk through a metaphor that characterises strategy as a stool that simultaneously balances ends, ways and means. He notes that when an imbalance exists between any of the legs of the stool, strategic risk emerges:

If military resources are not compatible with strategic concepts or commitments and/or are not matched by military capabilities, we may be in trouble. The angle of tilt represents risk… To ensure national security the three legs of military strategy must not only exist, they must be balanced.2

Beyond this definition, Lykke offers the theatre planner no clear guidance on how to identify, measure, or mitigate strategic risk. This study addresses those limitations by arguing as its thesis that Lykke’s model of strategy as a balance between ends, ways and means implies three distinct kinds of risk that will differentially impact the likelihood of success for any theatre security strategy. These three types of strategic risk—aspirational, design and menu risk—possess unique characteristics and offer specific challenges to operational planners. A discussion of their impact on theatre level planning, how they can be measured, and ultimately mitigated serves as the central focus of this analysis.

The decomposition of risk

According to Lykke, risk occurs when there is an imbalance between the ends, ways and means of strategy. Strategic risk results when any two of these three strategic elements are
mismatched. Consequently, strategic risk or $\Theta$, can be viewed as the sum of the possible imbalances between ends, ways and means. Equation (1) below identifies the three distinct imbalances that are possible:

$$\Theta = \{ |E-M| + |E-W| + |W-M| \} \quad (1)$$

where $E$ = the ends of a specific strategy
$W$ = the ways of a specific strategy, and
$M$ = the means of a specific strategy.

The first term to the right of the equals sign is the component of strategic risk attributable to an imbalance between ends and means. This risk is called ‘aspirational risk’ since it reflects the mismatch between the ends to which the combatant commander aspires and the resources available to achieve those ends. The second term expresses the imbalance that might exist between ends and ways. If the operational planner selects a way that is inconsistent with the desired ends, then strategic implementation is poorly designed and creates risk. Consequently, this risk is termed ‘design risk’. The last term captures the strategic uncertainty that arises from an imbalance between the selected way and the available means. This risk is called ‘menu risk’, since it occurs when the operational planner chooses a selection from the menu of ways that is more costly than can be supported by the available means.

Figure 1 presents a graphic illustration of how ends, ways and means influence strategy and ultimately, policy. In panel A, theatre strategy is in balance with ends, ways and means all aligned. Policy is likewise in balance and rests on a strategy in equilibrium. In panel B, strategic wobble occurs as an imbalance emerges between ends, ways and means. This wobble might result from an imbalance between all three components of strategy or from a pair-wise imbalance. At this point, the imbalance is not fatal to strategy, but it does cause strategic oscillation and policy can begin to shift. In panel C, the imbalance between the ends, ways and means becomes so severe that the theatre strategy collapses, with consequent implications for policy.

The remainder of this article examines the specific kinds of imbalances that can occur between ends, ways and means and describes how the operational planner can measure and manage the resultant risks. The insights provided by this analysis will allow the operational planner to identify and measure these risks which are inherent in all strategy. Such an exercise will also guide the planner in selecting those mitigation techniques which can best prevent policy failure by maintaining either a strategic balance or wobble.

**Aspirational risk**

Aspirational risk represents that aspect of strategic risk resulting from a mismatch between ends and means. Aspirational risk reflects the limiting factor of resources in the achievement of strategic ends. Because this is the most common risk faced by planners, they develop it in greater detail and elaborate upon its special bi-directional nature in which means might exceed ends or ends might exceed means.
Figure 1: The balancing of ends, ways and means and the emergence of strategic risk.
Type I Aspirational risk: over-reach

Imbalance between strategic ends and means can also occur when the operational planner over-reaches and the ends exceed the availability of means to support them. Operation Barbarossa, Hitler’s invasion of the USSR, suffered from this type of risk. Similarly, the UK was constrained by possible over-reach risk during its war for the Falkland Islands in 1982. Over-reach risk is closely related to the hypothesis of ‘imperial overstretch’ developed by British historian and author, Paul Kennedy, whereby the strategic commitments and interests of a nation exceed its ability to defend them:

If a state overextends itself strategically, by say, the conquest of extensive territories or the waging of costly wars—it runs the risk that potential benefits from external expansion may be outweighed by the great expense of it all.4

Jeffrey Taliaferro, a Yale political scientist, analysed Japan’s attack on the United States in 1941, and describes the strategic thinking leading to that decision in terms consistent with aspirational over-reach risk. During the 1930s Japan desired to create ‘a continental empire that would make Japan economically self-sufficient, and thereby, secure’.5 Such a strategy involved a southward advance by Japan into French Indochina and the Dutch East Indies to acquire raw materials. This would, however, provoke conflict with the US and the UK. Yet Japan persisted and Taliaferro writes that officials knew ‘Japan could not win a prolonged war and that any war had a high probability of lasting several years’.6

Type II Aspirational risk: under-reach

A less common case of aspirational risk occurs when means exceed ends. Type II aspirational risk refers to the case when the means exceed the ends. This is similar to those strategic circumstances that the French general and strategist, Andre Beaufre, identifies as ‘ends moderate, means large’.7 Such an imbalance poses the possibility of strategic under-reach, with the operational planner achieving less than is possible given the means that are available. Beaufre illustrates this type of risk with the Cold War nuclear deterrence strategy of the US. The end selected for this strategy was very basic and limited to the survival of the US as an independent nation. The means available to achieve such an end, however, were abundant. Two more recent examples of under-reach, where modest ends were combined with abundant means, are Operation Urgent Fury (Grenada, 1983) and Operation Just Cause (Panama, 1989).

When means exceed ends, there is the danger that ends will expand to consume the available means. An expansion in strategic ends that originates from abundant means rather than a careful strategy formulation process is known as ‘mission creep’. Defence analyst Adam Siegel notes that mission creep can generate risk to strategy by causing a loss of focus, entanglement, and the misuse of assets, especially military capabilities. His concept of mission shift closely matches this article’s view of mission creep as unplanned growth in strategic ends:

Mission shift occurs when forces adopt tasks not initially included that, in turn, lead to mission expansion. There is a disconnect between on-the-scene decisions to involve forces in additional tasks and political decision-making about objectives.8
**Measuring aspirational risk**

The mission analysis step of deliberate planning requires the planner to analyse the assigned task and determine the military objective (end) and to identify resources available (means) for use in developing the plan. It is at this point that the planner must make an initial assessment of the magnitude of aspirational risk. The grid contained in Table 1 can provide the planner with a method for measuring the extent to which aspirational risk is present.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Factor Evaluation and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likely (1)</td>
</tr>
<tr>
<td>The desired objective can be scaled back.</td>
<td></td>
</tr>
<tr>
<td>The time to achieve the desired objectives can be extended.</td>
<td></td>
</tr>
<tr>
<td>The objectives can be prioritised and phased in.</td>
<td></td>
</tr>
<tr>
<td>A subset of the objectives can be delayed.</td>
<td></td>
</tr>
<tr>
<td>Resources can be increased to support this course of action.</td>
<td></td>
</tr>
<tr>
<td>Resources can be borrowed or reallocated from other programs.</td>
<td></td>
</tr>
<tr>
<td>Resources are available from allies or coalition members.</td>
<td></td>
</tr>
<tr>
<td>It will be possible to recruit new allies.</td>
<td></td>
</tr>
<tr>
<td>Host nation or in-theatre resources are readily available.</td>
<td></td>
</tr>
<tr>
<td>Existing resource inventories can be accessed.</td>
<td></td>
</tr>
</tbody>
</table>

**Sum of each column**

**Grand total of the column sums above**

*Table 1: Measuring aspirational risk.*
The planner begins his or her estimate of aspirational risk by screening the assigned task and the resources that have been identified against the factors listed in Table 1. The planner is required to evaluate each factor as likely, uncertain, or not likely. Each assessment carries a corresponding point value indicated in parentheses. The scores are summed and a final numerical value is calculated. Because there are ten factors, the final score can range from 10 to -10. The planner will then interpret the aggregate factor score as described in Table 2. This assessment will permit the planner to better evaluate the risks facing mission accomplishment and help in the design of a more effective course of action.

<table>
<thead>
<tr>
<th>Aggregate Factor Score</th>
<th>Extent of Risk Present</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 to 7</td>
<td>None</td>
</tr>
<tr>
<td>6 to 3</td>
<td>Little</td>
</tr>
<tr>
<td>2 to -2</td>
<td>Moderate</td>
</tr>
<tr>
<td>-3 to -6</td>
<td>High</td>
</tr>
<tr>
<td>-7 to -10</td>
<td>Dangerous</td>
</tr>
</tbody>
</table>

*Table 2: Assessing the extent to which risk is present.*

**Mitigating aspirational risk**

The presence of aspirational risk can be mitigated through one of two general methods that are summarised in Table 3. The first is to adjust the ends so that they are consistent with the available resources. Most commonly, this will involve scaling back the ends so that the resource constraints become less binding. The second method is to modify the means. Usually, this will require the operational planner to identify additional resources. These two approaches can also be used in combination, with simultaneous adjustments to ends and means. The extent of aspirational risk as measured in Table 2 will determine which methodologies for risk mitigation described in Table 3 are most appropriate.

**Design risk**

*The concept of design risk*

Design risk results from an imbalance between a strategy's ends and the ways selected to accomplish them. Because it contrasts strategic ends with the various methods designed to
Panel A: Adjusting the strategic ends

<table>
<thead>
<tr>
<th>Mitigation Method</th>
<th>Example of Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale back the desired objectives</td>
<td>1973 Paris Peace Accords (US and North Vietnam)</td>
</tr>
<tr>
<td>Pursue the objectives over a longer interval</td>
<td>US’s Global War On Terrorism</td>
</tr>
<tr>
<td>Delay a subset of the objectives</td>
<td>Hitler’s decision to delay Operation Sea Lion, the invasion of the UK</td>
</tr>
<tr>
<td>Prioritise the objectives and then phase-in</td>
<td>US Pacific island campaign: World War II</td>
</tr>
</tbody>
</table>

Panel B: Adjusting the strategic means

<table>
<thead>
<tr>
<th>Mitigation Method</th>
<th>Example of Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase the amount of resources</td>
<td>Mobilisation of the US economy during World War II</td>
</tr>
<tr>
<td>Borrow from other programs, reallocate, or deficit finance</td>
<td>Operation Iraqi Freedom</td>
</tr>
<tr>
<td>Obtain resources from allies or coalition members</td>
<td>1991 Gulf War</td>
</tr>
<tr>
<td>Recruit new allies</td>
<td>US’s Global War On Terrorism</td>
</tr>
<tr>
<td>Fund in phases (pay as you go)</td>
<td>US’s strategy for the Cold War</td>
</tr>
<tr>
<td>Consume seed capital</td>
<td>Japanese economy during World War II</td>
</tr>
<tr>
<td>Obtain resources from realised objectives (live off the land)</td>
<td>German policy on the Eastern Front: World War II</td>
</tr>
</tbody>
</table>
Donald Kagan, academic historian and author, describes Athens’ strategy for the Second Peloponnesian War as defensive in nature accompanied by nuisance raids against Sparta that only implied Athenian naval power:

…the Athenians were to reject battle on land, abandon their fields and homes in the country to Spartan devastation and retreat behind their walls. Meanwhile, their navy would launch a series of commando raids on the coast of the Peloponnesus. This strategy would continue until the frustrated enemy agreed to make peace.9

This strategy, however, contained substantial design risk. For Athens ultimately to prevail it needed to defeat Sparta on the land. But Athens shrank from the cost that such a strategy would require. It was unwilling to select the way necessary to achieve its strategic ends against a determined enemy. Athens chose a way that emphasised the defensive, but the nature of the enemy ‘made the Athenian way of warfare inadequate, and Pericles’ strategy was a form of wishful thinking that failed.’10

A more recent example of design risk occurred with US military operations in Indochina. Colonel (Retd.) Harry Summers, author and military strategist, argues that there was a mismatch between the ends and ways of the US’s involvement in Vietnam. The way selected by US strategists was inconsistent with US ends. Summers contends that this mismatch resulted in the selection of a way that was deeply flawed:

But instead of orienting on North Vietnam—the source of the war—we turned our attention to the symptoms—the guerilla war in the south. Our new ‘strategy’ of counterinsurgency blinded us to the fact that guerilla war was tactical and not strategic. It was a kind of economy of force operation on the part of North Vietnam to buy time and to wear down superior US military forces.11

**Measuring design risk**

The operational planner becomes concerned with design risk at that step in the concept development phase when possible courses of action (COA) are identified. At that point, any imbalance between ends and ways becomes highly relevant. The grid contained in Table 4 presents a method by which the operational planner can assess the magnitude of design risk that might be present in the planning process. Similar to the assessment of aspirational risk, the aggregate factor score can be estimated and the magnitude of design risk can be evaluated with reference to Table 3. This assessment operationalises the concept of design risk and allows it to be explicitly incorporated into the planning process.

**Mitigating design risk**

Since design risk involves an imbalance between ends and ways, the mitigation of this risk requires a closer realignment of these strategic elements. This can be accomplished by focusing on the ends, on the ways, or some combination of both. Table 5 describes how design risk has been mitigated historically and suggests techniques for use by operational planners seeking to reduce such risk. These examples illustrate the usefulness to the planner of attempting to measure the extent of design risk. By determining the magnitude of design risk, the planner is better able to design a course of action or to recommend changes in a plan’s objectives that will more likely achieve strategic success.
Menu risk refers to an imbalance between the ways and means of strategy. This type of risk occurs when the operational planner chooses from the menu of ways a strategic entrée that is too expensive. Menu risk reflects the mismatch between the requirements of a given way and the means available to execute it.

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Factor Evaluation and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likely (1)</td>
</tr>
<tr>
<td>The desired ends can be scaled back.</td>
<td></td>
</tr>
<tr>
<td>The time to achieve the desired ends can be extended.</td>
<td></td>
</tr>
<tr>
<td>The ends can be prioritised and phased in.</td>
<td></td>
</tr>
<tr>
<td>A subset of the ends can be delayed.</td>
<td></td>
</tr>
<tr>
<td>The COA can be accelerated in time.</td>
<td></td>
</tr>
<tr>
<td>The COA does not emphasise attrition for its success.</td>
<td></td>
</tr>
<tr>
<td>The COA allows for the use of other elements of national power.</td>
<td></td>
</tr>
<tr>
<td>The COA allows for measurable progress towards the desired end.</td>
<td></td>
</tr>
<tr>
<td>The COA can be calibrated in its implementation.</td>
<td></td>
</tr>
<tr>
<td>The COA is viewed as legitimate.</td>
<td></td>
</tr>
<tr>
<td>Sum of each column</td>
<td></td>
</tr>
<tr>
<td>Grand total of the column sums above</td>
<td></td>
</tr>
</tbody>
</table>

Table 4: Measuring design risk.
<table>
<thead>
<tr>
<th>Mitigation Method</th>
<th>Example of Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtain periodic assessment of progress towards the desired end.</td>
<td>US manned lunar program</td>
</tr>
<tr>
<td>Invite participation of representatives of the other elements of national power.</td>
<td>Mobilisation of the German and US economies during WW II.</td>
</tr>
<tr>
<td>Invite the participation of allies or coalition members to enhance the way’s perceived legitimacy.</td>
<td>Operation <em>Enduring Freedom</em> (Afghanistan)</td>
</tr>
<tr>
<td>Undertake a media or public relations campaign to obtain an expanded or more acceptable set of ways.</td>
<td>Operation <em>Iraqi Freedom</em> (e.g. embedded reporters)</td>
</tr>
<tr>
<td>Change organisational structure, including command and control relationships, to permit implementation of the selected way.</td>
<td>US’s creation of NorthCom and the Department of Homeland Security</td>
</tr>
<tr>
<td>Expand the scope of the selected way or intensify its implementation.</td>
<td>US firebombing campaign against Japan, 1945</td>
</tr>
</tbody>
</table>

Table 5: Methods for mitigating design risk.

An example of menu risk

Following the First World War, France sought to improve its security by developing a network of alliances and international agreements. France anticipated that this system of alliances would allow it to defeat any nation that attempted to disrupt the European status quo.

But Army historian Robert Doughty observes that:

In the quest for a military strategy, the French had to balance the conflicting requirements of organising and equipping military forces that could simultaneously protect their frontiers, provide assistance to their eastern friends, and defend their lines of communication in the Mediterranean. Unfortunately, France did not have sufficient military forces for all these requirements. In the final analysis, French grand strategy proved inadequate...¹²

By the late 1920s a gap had opened between the ways of French security strategy and its military capabilities. The ways of French inter-war strategy involved commitments to allies that required
a military force capable of ‘strategic manoeuvre and of offensive action against Germany’. But by 1930, France ceased to possess the ability to initiate offensive operations against Germany, and French strategists faced significant challenges resulting from menu risk.

**Identifying and responding to menu risk**

The Threats-Opportunities-Weaknesses-Strengths (TOWS) matrix of strategic analysis, originally developed by business professor Heins Weihrich, can be modified to aid in the identification of menu risk and to suggest responses or techniques for its mitigation. In Table 6 the available means are scaled on the vertical axis and range from low to high. A high level of means represents a strategic strength while low means are a weakness of the chosen strategy. The available means are then compared with the resource demands required by a given strategy. Strategies with a high demand for resources are more costly to execute and attract greater debate/review because of their higher opportunity costs. Consequently, such choices are less attractive to planners and in this sense are ‘threatening’. Alternatively, strategies requiring a lower level of means generate less competition for resources, making their adoption and implementation easier. Consequently, they can be seen as an opportunity for the operational planner.

The cells in Table 6 provide the operational planner with an indication of when menu risk might occur and options for response and mitigation. In cell HL (high means, low demand), the operational planner faces no menu risk. The means are abundant relative to the resources

<table>
<thead>
<tr>
<th>Level of Available Means</th>
<th>Demand for Resources by Selected Ways</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Cell HL: Execute the selected ways; exploit emergent strategic advantages.</td>
</tr>
<tr>
<td></td>
<td>No menu risk.</td>
</tr>
<tr>
<td>Low</td>
<td>Cell LH: Seek to overcome limitations and exploit opportunities. Seek to expand means.</td>
</tr>
<tr>
<td></td>
<td>Potential menu risk.</td>
</tr>
<tr>
<td>High</td>
<td>Cell HH: Execute the selected way.</td>
</tr>
<tr>
<td></td>
<td>Limited menu risk.</td>
</tr>
<tr>
<td>Low</td>
<td>Cell LH: Must reduce the means required by the selected way.</td>
</tr>
<tr>
<td></td>
<td>High menu risk.</td>
</tr>
</tbody>
</table>

**Table 6:** The threats and opportunities associated with menu risk.
demanded by the selected way. Such a relationship suggests that the Combatant Commander implement the selected way, while exploiting any new opportunities that might emerge.

In cell HH (high means, high demand), the operational planner again should execute the selected way, but recognise the potential for menu risk. Although the available means are high, the ways demand significant resources. This imbalance creates the possibility of menu risk in the future. Consistent with the relationship presented in cell HH, the attrition strategy of the Western Front during World War I generated a menu risk in which the belligerents ‘could succeed only by wearing down enemy resources and willpower at a faster rate than their own’.14

The bottom two cells represent resource-limited environments. In cell LL, (low means, low demand) the strategist should seek to overcome the constraints of limited means and attempt to exploit the advantages inherent in a low-cost way. Menu risk is possible if the modest demands of the way ultimately exceed the means available. Military historian and analyst Michael Handel notes how Israel’s small population has forced that nation to depend heavily on reservists, thereby requiring that ‘wars must end quickly and decisively to avoid or minimise the economic paralysis caused by total mobilisation’.15 The limited size of the Israeli armed forces has resulted in the selection of ways that attempt to reduce a military conflict to the shortest possible duration and to employ ‘resource intensive warfare’ to reduce casualties.16

In cell LH (low means, high demand), there is clear menu risk. The selected ways are resource intensive, while the means available to the strategist are insufficient. To eliminate this risk, the operational planner must reduce the level of means required by the selected way. The German Ardennes offensive of December 1944 exemplifies menu risk in such an environment. The putative objective for this offensive was ‘to cripple the attack capabilities of the Allied armies and chew up their divisions east of the Meuse’.17 With an attrition-like objective in mind, the selected way—a ground offense—would be highly demanding of resources. But Army historian Hugh Cole describes the German armies in the Ardennes in 1944 as ‘fighting a poor man’s battle’,18 with acute logistics shortages. Although the German forces initially overwhelmed the Allied defenders, they were unable to make up their losses. The limited means available to Germany to execute this way were quickly exhausted. Menu risk ultimately doomed the German offensive to collapse.

Measuring menu risk

Comparable to the process for assessing aspirational and design risk, the operational planner must evaluate menu risk when formulating courses of action during the concept development phase. The grid provided in Table 7 allows the planner to evaluate the resources available to support a course of action and thereby determine the extent to which menu risk is present. The aggregate factor score obtained from the planner’s application of Table 7 can be assessed against the guidelines provided in Table 3. This will allow the planner to determine the extent to which menu risk is present in a specific course of action.

Further, the risk factors listed in Table 7 also imply a set of mitigation measures that can reduce the level of design risk present in any given plan. In this sense, the interrogatories contained in Table 7 can be used to migrate a plan across the threats and opportunities matrix presented in Table 6. For instance, by obtaining host nation support or reallocating resources from other
programs, a plan can increase the level of means available for its execution and move from cell LH (high menu risk) to cell HH (limited menu risk).

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Factor Evaluation and Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Likely (1)</td>
</tr>
<tr>
<td>Resources can be increased to support this course of action.</td>
<td></td>
</tr>
<tr>
<td>Resources can be borrowed or reallocated from other programs.</td>
<td></td>
</tr>
<tr>
<td>Resources are available from allies or coalition members.</td>
<td></td>
</tr>
<tr>
<td>Existing resource inventories can be accessed.</td>
<td></td>
</tr>
<tr>
<td>Host nation or in-theatre resources are readily available.</td>
<td></td>
</tr>
<tr>
<td>The course of action can be accelerated in time.</td>
<td></td>
</tr>
<tr>
<td>The course of action does not emphasise attrition for its success.</td>
<td></td>
</tr>
<tr>
<td>The course of action allows for the substitution of technology for personnel.</td>
<td></td>
</tr>
<tr>
<td>The course of action represents an asymmetric attack.</td>
<td></td>
</tr>
<tr>
<td>The course of action can be calibrated in its implementation.</td>
<td></td>
</tr>
</tbody>
</table>

**Sum of each column**

**Grand total of the column sums above**

Table 7: Measuring menu risk.
Conclusion

The concept of strategic risk as originally developed by Lykke is under-developed and remains of little practical use for staff planners or others involved in the design of theatre-level security strategies. This article attempts to operationalise Lykke’s idea of strategic risk by developing three new concepts of risk that are inherent in his model. These new risk concepts can be separately identified, measured and ultimately mitigated by staff planners. By developing and illustrating through historical example the concepts of aspirational, design and menu risk, this article allows a theatre-level planner to better understand the risks associated with a specific security strategy. But beyond creating these new risk concepts, this article provides a useful set of analytical tools for the planner to determine the extent to which these risks are present and how they might be mitigated in the development of courses of action.

Through a careful process of measurement of each of these risks, the planner can better identify which risk mitigation methodology is most appropriate. Such an approach to planning will increase the likelihood of choosing a course of action that will contribute to strategic equilibrium and the achievement of policy objectives.

The concepts of aspirational, design and menu risk allow theatre planners to better assess the kinds of risk that are relevant to the planning process. The techniques described in this article allow the careful measurement of these risks and imply appropriate risk mitigation techniques. The thesis of this article suggests both theoretical and operational contributions which can enhance the ability of the theatre planner to select a course of action which ultimately proves successful.

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NOTES


3. There are several assumptions that underlie equation (1)’s decomposition of strategic risk. The first is that strategic risk is additive. This follows from Lykke’s model where strategy is defined as the sum of the ends, ways and means. The second assumption is that there are no interactive effects. To the extent that there is a significant covariance between the risks, equation (1) is not fully specified. Such interactive effects, however, are likely to be secondary to the primary effects attributable to aspirational, design and menu risks. Third, the model assumes that the risks are equally weighted. Again, this follows from Lykke’s original specification in which ends, ways and means are of equal importance in the formation of strategy. Consequently, we further assume that the theatre planner weights each risk proportionately, which in this case implies equally. Finally, the mathematical operators of absolute value are meant to indicate the assumption of symmetry in the effect of any imbalance. For instance, aspirational risk might exist because either the ends are in excess of the available means or the means are in excess of the strategy’s stated ends. This model recognises the possibility of an imbalance in either direction, but does not differentiate regarding the magnitude of their contribution to the total risk of the strategy.


6. ibid., p. 95.


8. Adam B. Siegel, ‘Mission Creep or Mission Misunderstood?’, Joint Force Quarterly 25, Summer 2000, p. 113. Siegel contends that mission creep really represents a continuum of mission changes. It ranges from task accretion, which represents the accumulation of added tasks necessary to accomplish the original objectives, to mission shift, to mission transition when a mission undergoes an unclear or unstated shift of objectives, and finally to mission leap which is an explicit policy choice to change objectives and military tasks.


10. ibid., p. 54.


13. ibid., p. 495.


16. ibid., p. 551.


18. ibid., p. 663.
The Pen and the Sword

L. Rees, DSTO, Captain D. Lush, Australian Army and Major B. Stanton, Australian Army

One of the challenges facing Defence is the question of how to successfully field a military adviser/civilian analyst team to provide analytical support to commanders in the field. This article documents the research and the experience of the authors in facing and overcoming the difficulties peculiar to this type of activity.

The professional preponderance of specialist expertise can confuse the issue. The rigour of the scientific method, the diversity of team members, and the rigidity of the Australian Defence Force (ADF) itself compound the problem of achieving a scientific objective while operating in a military environment.

The solution to forming, applying and maintaining an effective science/military team is communication which facilitates trust and a coordinated approach to the problem space. The diverse backgrounds and capability of such a team focused through clarity of purpose and coordination give the team its unique strength and capability. The unique edge of such a team lies in the diverse backgrounds of the team members focused through common goals with clear roles and responsibilities. The surprise is that forming, maintaining and applying successful teams are far more reliant on the process of interaction between the team members rather than the analytical techniques or the brilliance of an individual. What really matters in such a team is the ability of the members of the team to work effectively towards coherent and relevant goals.

Introduction

Within an ever-changing operational environment,¹ the ADF requires credible and timely analytical advice to be available to commanders. A small science/military team mix can meet this requirement. This article uses a military training exercise environment and the experiences of the authors to explore the unique challenges that face such a team.

I found myself sitting in a green tent wondering what to do next. I could see some people hovering around a map with indecipherable symbols, frantically moving their hands in all directions, radios blaring in deafening chaos, and a voice hollering from behind me saying, ‘It is all turning bad sir 2 Platoon has been overrun and we are next.’ I look at the stack of collection sheets in my hand and groan inwardly – at least I hope it was inwardly – at the blank paper staring back mockingly at me. {Field Analyst}*

* The narratives are intended to illustrate the experience of undertaking scientific analysis under field conditions; it is a central theme of this article that the successful conduct of field-based analysis hinges on the ability to work with non-scientific professionals in unfamiliar environments, which are potentially hazardous.
It is no easy matter for a field analyst (FA) to conduct analytical studies in a military field environment—an environment that is foreign to many civilian analysts. However, the rewards are many and include the pride that comes from making a difference by having the team’s advice accepted, and seeing the resultant improvements. It embraces the sense of identity that comes from being a contributing member of a small team, and a sense of satisfaction in working closely with dedicated, professional Defence personnel who are doing their core job. Among the broad spectrum of analytical studies the Defence Science and Technology Organisation (DSTO) undertakes for Defence, the ability to deploy FA/military adviser (MA) teams is not something that Defence can do without. A well-functioning team provides a distinctive credibility to the results that few other approaches can match. It has the least impact on the unit or activity under study. A functioning FA/MA team allows efficient and effective studies to be completed with limited personnel in comparison with deploying a civilian analyst or military staff member individually.

The individual challenges for the FA in such a team include the nature of the military environment, and the sense of dislocation and sometimes isolation that comes from being a civilian in an otherwise completely military setting. Understanding the context of the battle, the command and control structure, conventions of military briefings, the military protocols and the sometimes difficult physical requirements to carry a pack and webbing and ‘keep up the pace’ present their own challenges for the FA. Additional challenges include the inherent cultural differences between DSTO and the military, the acronym rich environment and just living in the field environment, learning to sleep comfortably under a ‘hootchie’ and making the ration pack meals palatable. The demand for rapid results and advice is not well aligned to the usual conveniences of scientific study. The team cannot isolate an object of study to exert control over the military field environment. For the MA, the rigour of the scientific process and the need for constant questioning to capture the necessary detail associated with the collection process, are potentially at odds with their military training. But even within this chaos, the interesting aspect is that, it is not about a brilliant scientist or military officer, but how well the FA and MA work as a team that is paramount. The catalyst for this unique teamwork is communication, facilitating a bond of trust. Other properties include common goals, mutual respect, and the definitions of clear roles and responsibilities between team members. These properties while simple in concept present challenges in the development, formation, application and maintenance of such a team.

My military counterpart whispered something into my ear and jotted a comment on a piece of paper and disappeared from the tent. His final words as he left were ‘I will leave you with it. You know what you are doing.’ The paper read – you are briefing the commander in 15 minutes, with our key findings. {Field Analyst, Military Adviser}

This article discusses approaches to meet the challenges of an FA (the ‘Pen’)/MA (the ‘Sword’) team to gain the benefits of applying such a team. A test case is supplemented by the experiences of the authors, all of whom have operationally deployed and have worked as part of an FA/MA team. The civilian author has worked with more than one hundred military advisers across ten nations, including personnel from the ADF, and within international army programs. The experiences of the authors are used to inform discussions relating to the development, forming, application and maintenance of FA/MA teams. A field engineering exercise provides the test environment for such a team.
Why bother?

Land Operations Division (LOD) evaluates Land Force activities using analytical strategies to provide advice to Army. This advice informs the ADF on potential vulnerabilities in the conduct of its operations, and identifies potential change through process, organisation, or technology. Applying scientific approaches brings rigour, structure, method and consistency to the evaluation process. Such approaches might feature system models incorporating measurement parameters for evaluation to address the ‘why’ and for ‘solving and identifying the right problem’. The use of FA/MA teaming informs policy and actions for Defence decision makers, using scientific approaches providing credible, high-quality, timely results, achieved with limited personnel and minimal impact to a unit.

Just before I walked into the foreboding briefing tent, I called my military adviser over to warn him about the results. ‘The findings are not convenient for the commander, which could be a hard lesson to learn. I am concerned about his response.’ {Field Analyst}

He replied ‘You have achieved the results to the best of your ability and we can defend them. Remember you are doing a military brief; keep it factual, short and sharp. If he wants clarification he will ask for it. The commander is more likely to respect honesty and directness over smoke and mirrors, because he will instinctively know the difference, and he is the one that makes the final decision not you, you are only providing advice. I have your back.’ {Military Adviser}

We moved into the tent to conduct the brief for the commander. In typical military arrangement, a row of green canvas deck-chairs greeted me with a sea of expectant faces waiting as I moved nervously to the front of the tent. The briefing started with the commander sitting in long silent thought and a cold stare directed right at me. {Field Analyst}

He then asked in a loud condescending voice: ‘So have you identified a new problem, developed a new solution, or are you just going to tell me what I want to hear in a thousand words?’ {Commander}

With my nerves at a peak, I looked at my MA standing to the rear of the tent for some help; he nodded at me in support. I decided to stand my ground and supply the facts as I saw them. After taking a deep breath, I replied in a somewhat calm voice ‘We still think the problem is a good one for investigation, but the solution you have been running fails on the four agreed measures of system performance. It would work well in some contexts, but not in what you are doing today.’ {Field Analyst}

The commander while leaning forward in his seat, nodded and responded in a more engaging voice ‘Why did it fail, recommendations?’ {Commander}

I replied a little more confidently this time ‘The system specifically failed against the C2 mechanisms and information overload. Strategies for change could include: an adjustment in monitoring the C2 system, by changing processes so reporting is not all conducted at the same time, currently resulting in overload of the communication bearers. This one change for the headquarters process would address all four of the key measures.’ {Field Analyst}
The Commander nodded in agreement and said, ‘Agreed and confirms my suspicions – Operations Officer we need to get together with the analysis team to identify changes for tomorrow’s serials – arrange a time for this evening’. {Commander}

While the scientific/military mix within a team may be unique, its team qualities are common to effective teams in general. Existing literature extensively explores team dynamics and their effectiveness; but there is a lack of specific information related to a military and scientific civilian mix composition. The literature identifies trust as an underpinning factor related to teamwork and respecting individual and tribal differences. Other areas of interest include valuing diversity, developing cooperative goals and engaging in self-reflection and reflexivity, promoting collaborative conversation, taking time and developing trust. The need for respect and trust between members, a willingness to protect and support each other, engage in open dialogue and communication, share a strong common goal, have strong shared values and beliefs, subordinate their own objectives to those of the team and subscribe to ‘distributed leadership are highlighted in note 4. Note 5 reinforces effective team characteristics of a shared vision and a sense of mission; clear roles and expectation; cooperation; support; communication; trust; problem solving and adaptability. Additions to this list include vision, commitment, inclusion, and help exchange as outlined in note 6. Further, to build successful teams there is a need for clear expectations; understanding; context; commitment; competence; charter; control; collaboration; communication; creative innovation; understanding of consequences; and coordination between team members.

After the briefing, the ‘Sword’ and the ‘Pen’ left the large green tent together. My military adviser whispered in my ear, ‘great job – we are in thanks to you’, I replied ‘thanks for the help and the pep talk’. {Field Analyst}

The authors’ experiences highlight similar aspects to that found in the literature. The described properties underpin the team and its members’ ability to function effectively. The ‘willingness’ of team members to support each other to work in a cooperative and collaborative manner and prescribing to distributed leadership enhance the team’s functionality. The literature associated with team dynamics supports the experiences of the authors illustrated in the above narrative.

Forming, maintaining and applying these types of teams in a military environment provide unusual challenges. These teams are often put together at short notice, for studies in military exercises, military experimentation, informing capability development options, and operational deployments with little lead time. While both team members are competent in their own fields, it is the uniqueness of this type of mix, the environment in which it is applied; its strength and its pitfalls that are of distinctive interest.

Command, cooperation and creed: the challenges

If everyone is moving forward together, then success takes care of itself.

Henry Ford

The FA/MA team balances military knowledge and experience, the ‘Sword’, with scientific rigour, the ‘Pen’, to meet desired study outcomes with minimum impact to the unit. The challenges
for such a team are enormous. These challenges are only overcome through the ‘Pen’ and the ‘Sword’ working together effectively. The team needs to cope with the military environment, and endeavour to be a cohesive force to face adversity as a team while understanding the conflicting backgrounds between the team members. The uniqueness of applying the team in a military operational or exercise environment, while achieving a scientific goal, presents a challenge for the team. The team members ‘must have a willingness to be a part of the team’, and to achieve the required common goals of the team. Enforced or engineered ‘willingness’ between team members becomes neither genuine nor effective.8 The key is internal integration (done individually between team members) and external adaptation (done as a team as a whole).

**Teamwork**

Teamwork is the ability to work together toward a common vision. The ability to direct individual accomplishments toward organisational objectives. It is the fuel that allows common people to attain uncommon results.

Andrew Carnegie

A cohesive FA/MA team meets individual and team challenges together. Its edge is gained through unifying disparate backgrounds, clarity of purpose and the rapport between team members—in short, teamwork grounded in communication and a willingness to meet its challenges together.

This section discusses the team properties and their importance in developing functioning teams that provide high quality advice effectively and efficiently to Defence. The section highlights the challenges in developing, applying and maintaining the ‘Pen’ and the ‘Sword’.

As we left the briefing tent it finally dawns on me, ‘Time to step up to the mark’. The ‘Pen’ has delivered the initial results to the commander, he is happy with the rigour applied and comfortable the results are a true reflection of what is happening within his command. The problem now is that he wants changes implemented and will expect to see results. {Military Adviser}

My ride to this point has been fairly smooth. Understanding what the ‘Pen’ needs, help her get the right information, avoid an adverse impact on the unit and ‘voila’; the ‘Pen’ produces some outstanding results from what she claims was minimal data (how 14 days of data collection equals ‘minimal’ I’m still struggling with, but that’s the difference between the military and the science). {Military Adviser}

The job at hand required an understanding of the unit, that bit’s easy and a detailed understanding of the analyst’s findings as they related to this specific problem space. My role here is to be the translator from scientific findings into military procedures, not an easy task when considering the vastly different cultures. {Military Adviser}

Thankfully the ‘Pen’ and I had spent considerable time in planning, so I clearly understood the science behind our work. As I run through my own appreciation process I cannot escape one crucial fact, so I turn to the ‘Pen’, ‘So, how exactly did we get these specific results’. Needless to say, doing picket would have given me much more sleep that night. {Military Adviser}
Granting belief – Trust and respect

Whoever is careless with the truth in small matters cannot be trusted with the important matters.

Albert Einstein

There are countless ways of attaining greatness, but any road to reaching one’s maximum potential must be built on a bedrock of respect for the individual, a commitment to excellence, and a rejection of mediocrity.

Buck Rodgers

Colonel Papararone,9 discusses what it takes to gain soldierly trust swiftly, allowing the quick establishment of working relationships with complete strangers. He identifies several variables associated with this trust, including reputation, conversation, health, safety, investments, hierarchical position, perceptions of adaptability, cognitive illusion of mastery, presumption of trustworthiness, prospect of future interaction and role clarity.

FA/MA teams often form at short notice. Trust is a vehicle for a team functioning effectively. While the team is forming and storming, communication is critical to this trust. As the quotes above highlight, small matters are important for the team. Trust occurs through little steps and grows from respect and understanding of individual capabilities. While trust builds over time, it is fragile and breaks easily. During application of the team, distributed leadership is an indicator for trust between members. Each team member must believe in the other’s competence. This creed is the binding for the ‘Pen’ and the ‘Sword’.

Chit-chat - Communication

The single biggest problem in communication is the illusion that it has taken place.

George Bernard Shaw

Communication works for those who work at it.

John Powell

The most important thing in communication is to hear what isn’t being said.

Peter F. Drucker

These three quotes amplify the foundation for any successful team: communication. Just ‘chit-chatting’ between team members is not enough; they must listen, pay attention and understand each other. The challenges facing the team include the jargon, terminology and abbreviations that each team member utilises from their backgrounds. The military brevity associated with briefings and the battle is at discord with the need to explain why for the scientific process. As the narrative suggests, communicating both the science and the military aspects is pivotal to the FA/MA team’s acceptance by the unit and commander. While the ‘Sword’ may not have an in-depth understanding of the science, he or she must know enough to be able to answer questions sourced outside the team. The ‘Pen’ will need to discuss the battle and brief in a succinct manner.
In the forming stage for the team, communication can occur through a formal process. Using a planning process allows the science and military aspects of any study to be discovered and discussed. When applying the team, structured daily team briefings between team members provide a useful mechanism for communication. Additionally, informal communication strengthens the team dynamics and could occur during mealtimes.

Who is in command? – Roles and a common goal

When a team outgrows individual performance and learns team confidence, excellence becomes a reality.

Joe Paterno

Strength lies in differences, not in similarities.

Steven Convey

The team members’ roles are central to the successful employment of the FA/MA team as in Figure 1. Here the FA is conducting discussions with a unit commander, while the MA provides Close Protection. Belbin\textsuperscript{10} identifies five principles for successful teaming. Firstly, that each team member contributes to achieving objectives by performing both a functional role (professional and technical knowledge) and a team role. Secondly, this is an optimal balance in both functional and team roles, depending on the team’s goals and tasks. The third principle states that team effectiveness depends on the extent to which members correctly recognise and adjust to the

Figure 1: Field analyst conducting discussions with a Unit Commander, while the military adviser provides close protection at a task during a military field exercise.
relative strengths within the team. The fourth principle recognises that a team can deploy its technical resources to best advantage only when it has the range and balance of team roles to ensure efficient teamwork. And finally, Belbin suggests that individual personality and mental abilities fit members for some team roles and limit their ability to play others.

A military specialist and civilian analyst included in the team bring the necessary wide range of functional expertise to understand and objectively test the problem space. As a team, both members need to perform various team roles, to ensure adequate exploration of the problem with the requisite product delivered in the time available. To that end, the FA and MA should exercise the necessary team roles according to the circumstances and personal preferences. The key to success is that, collectively, the team can deliver the outcomes and coordinate its application.

**Planning gives the team the edge – Preparation**

In preparing for battle I have always found that plans are useless, but planning is indispensable.

Eisenhower

The FA/MA team meets its most difficult challenge in planning. The team faces divergence in ill defined problem spaces and a scientific study outcome. This, while not always a problem, can create discord between the science and the military thinking. The process of resolution and better understanding of the problem space is more important to the team members than writing the perfectly articulated plan. The process of communicating aims, study objectives and the associated data requirements to support analytical rigour for the study forms the basis of the team plan. Documenting it in unnecessary detail can consume valuable data gathering time and cause unnecessary frustration for team members. The required detail will vary according to the situation, but usually sufficient to justify allocation of the client’s time and resources to the activity and to support the selected analytical methods. Polya and Williams provide simple generic strategies for planning considerations for any analytical study. Planning is not predicting what will happen and writing a plan on this basis, but anticipating what might happen and planning what one might do about it.

From the experience of the authors, a preparation phase for the team allows identification of the strengths and weaknesses of the team and the analytical techniques for the study. This phase converts team competencies and tasks into simple analytical strategies and resource allocation. For team aspects there is a focus on the team dynamics utilising clear roles and responsibilities. The principal analytical aspects of the study include the aim, objectives, scale, scope, incorporating observable and achievable assessment criteria. The military aspects include the battle context, and conversion of the analytical process into tasking in the form of troops to tasks, location and timings.

**The ‘Pen’ and the ‘Sword’ – The tips**

Coming together is a beginning. Keeping together is progress. Working together is success.

Henry Ford
The diversity in backgrounds of the ‘Pen’ and the ‘Sword’ bring a fundamental strength to the team; it is also its most common potential for failure. Differing cultures, the military environment in which to explore a scientific objective, the rigidity of the military ethos, and questioning of the scientific method are areas of potential conflict between team members. Without consultation and mechanisms to assist team dynamics, this diversity can negatively impact the team’s ability to function effectively. Each team needs to develop its own strategies to overcome these difficulties to come together, to keep together and to work together.

The following points provide valuable lessons learned for the team using the test case and the experiences of the authors.

The team together

Skills and experience of the team members in facilitation and communication strategies are important in successfully gathering information from military personnel. From the analyst’s experience, the manner in which the military team member introduces the civilian analyst to military personnel can be a critical factor in the acceptance of the FA, and the team, by the unit. While there are no hard and fast rules, each team will need to address this issue at some point. Communication is the key driver for teamwork and achievement of the study outcomes.

The team members’ ability to work together as an integrated unit is imperative to its effectiveness. The mix of the FA/MA team is a critical ingredient to achieving a study outcome. When applying the team to a military environment, techniques for facilitating communication between the team members is crucial to the effective functioning of the team. Time out for team members is a necessary aspect of teamwork, to ensure the team does not burn out. Physical activity is a good stress reliever for the team as a whole. Simple strategies should be developed by the team to ensure resolution of issues and celebration of successes. In the test case, every evening, the team reviewed the agenda for the next day and explored its own internal workings as outlined in the following list.

- Status of the scientific objectives.
- Aims and objectives for the next day.
- Time, space and resource allocations.
- Data requirements and collection locations.
- Liaison with the unit. Who is going to do this, and when will they do it?
- As the team is small, it is important that it does not burn out. It is best for the MA to lead this issue. This can incorporate downtime in the form of external activities, physical activity or just time apart for team members.
- Issues with the unit. Is the team causing any unnecessary burden on the unit? This can be explored through addressing FA/MA team improvement in interfacing with the unit as a collective, and individually. In this process it is important to also articulate where team members have done well and where the team as a whole has done well.
- Issues with the team. Explore areas where the team dynamics have not worked. Expressing this as assistance each team member may require to achieve a particular
activity can be useful if done non-confrontationally. Each team will need to identify and work out useful strategies to explore this area.

The FA/MA team requires consistent and structured approaches which are flexible in application. A mechanism for clearly defining the system and its scope is critical to focusing the analytical study. This also assists with the juggling of time frames and resource allocation for the task, while aligning first line analysis to reporting time frames. Techniques for data collection and analysis should be complementary and flexible in nature; disparate techniques will often confuse military personnel.

Team members should consider the expectations they have of each other and understand each other’s strengths and weaknesses. The FA should not be expected to conduct a 20 kilometre route march, and the MA should not be expected to understand the detail of the science. They both need to be able to form, storm and maintain a team in a military environment, weather, terrain, and with threats that are real whether on exercise or deployed. It is important not to transfer experiences from one team to another; this includes other FA/MA teaming, military and scientific teaming. Each team is unique; each will tackle the problem space and work together in different ways.

There are additional considerations. When considering the information used in this article, bear in mind it has been based on the experiences of a female field analyst working with male military advisers from a variety of ranks, countries, military backgrounds and age groups. A whole range of possibilities exists for awkward or even potentially threatening circumstances. It is important to be prepared.

Results

When delivering results, select the team member to lead the delivery of results according to the audience and the nature of the news, but deliver as a unified team. Don’t enter into arguments, the task is to present the advice and explain the rationale and impact. The commander does not need the method chapter and verse; provide enough information to reassure him or her of the credibility of the advice. The team’s advice is just one input the commander considers in making a final decision, and it may be rejected. The team brings a level of referent authority through its technical skills and appointment to the task.

Preparation

While both members of the team contribute to the analysis plan, the role of leading the development of such a plan falls with the FA due to its focus on scientific objectives. The MA should be totally involved in this process to gain an intimate understanding of requirements to achieve the scientific goals, the impact on military context and resource allocation. This is important to allow the MA to gain trust in the proficiency of the FA and the planning process. This provides some formality for the team to interact, especially in the early stages of forming a team.

The basic risk assessment planning process provides a formal way of identifying limitations associated with the team as a whole and how to address them. Allowing the FA/MA team as
a whole and individuals to discuss and address shortcomings within the team, its equipment and the tasking required in a non-threatening way adds to developing team cohesion. It highlights the unexpected and has the potential for team members to gain insights into how other members would address the problem space. It should include scientific problems, military aspects and safety. Highlighted risks need to be agreed and mitigated by both members of the team. As the risks are addressed, opportunities for the core strengths and weaknesses of the team can emerge in a non-confrontational manner. This process can allow the key area of trust to develop. It is important in this process that the team has control over this process. It is an internal team matter, not for external exposure.

**Harvesting the data**

The ability to observe activities and communicate effectively to elicit information from military personnel are core skills for harvesting data to support analytical field studies. Other competencies include an understanding of the system under study, methods to represent it, and identifying credible and agreed measurements to judge the system. Within a military field environment there is a single opportunity to collect the relevant data. Decision makers want timely delivery of workable advice—not perfect solutions that are too late to be useful. The team provides areas of uncertainty in their advice for consideration by the commander. This is where the FA/MA combination adds most strength to the team; the MA assists in interpreting the level of advice that will be useful to the commander. The FA contributes a selection of approaches to develop the advice. Standardisation for data collection will aid in collation and analysis practices, adding confidence in the results. The strategies selected must be applied and understood by both the ‘Pen’ and the ‘Sword’, as both need to contribute to generating and delivering the advice.

Examples for generic data collection include:

- **Briefings.** Attendance at formal briefings, patrol debriefs and other activity debriefs provide queues for information on tasking, activities, timings and locations.

- **Decision making.** Decision points within the battle, including the criteria and influences for decisions are critical in data collection. It should incorporate identification of decision points associated with branches, sequels and key events, resulting from the Military Appreciation Process (MAP).

- **The context, battle and technical systems.** The context of the battle requires recording of key objectives, events taking place within the battle, key factors influencing the battle, the environment, terrain and threat. Identifying units and their assigned technical systems such as sensors, communications, weapons and supporting processes for offensive support, targeting and C2 arrangements are significant in the data collection process and applicability of the results.

- **System description and boundaries.** The scope and scale of the problem space needs to be defined. This includes identification of boundaries and the scale of physical problem space for the study. Identification of functions and elements of the system allow a description of the system to be developed.
• **Interfaces.** Identification of all communication nodes. Interactions between elements. Formal and informal aspects need to be considered, incorporating logs, shift changeovers, informal discussions and physical location.

When harvesting data, exploiting each team member’s strengths allows greatest credibility in the data collected. Deploy the FA where there is a requirement to think questioningly, where there is ambiguity. Conversely, the MA concentrates on the context of the battle, describing key aspects of the battle, the events within the battle and the key factors influencing the battle. This also reduces observed bias from the military officer regarding process. Their training is to report factual information relating to the battle, and here they are still within their comfort zone. Using team members’ strengths provides confidence in the data collected resulting in better defensible results.

Having discussed the analysis, at length, it had become clear there was a requirement for more contextual data. I decided I needed to talk to the Operations Officer, alone, to focus how we would be able to meet the commander’s intent for these findings. I had found on previous activities that military staff can get a bit nervous when the scientist is around, expecting that they have been sent by the commander to ‘spy’ on them. I gathered all the appropriate information and wandered off to see the ‘Pen’ and put our plan together. {Military Adviser}

I must admit I was getting a little concerned at this stage, since there seemed to be far too much information to collect in the time available, but that is the nature of the beast. {Military Adviser}

‘Grab your note book’, I said nervously. ‘Here is the situation. The unit is starting to draw down the exercise, and there is only one window of opportunity left to gather the data we need. The extended clearing patrol tomorrow morning and reports to the headquarters will give us the data, but we will need to be split between the patrol itself and the TAC HQ.’ {Military Adviser}

The ‘Pen’ said, almost jokingly, ‘I guess I will just have to go on patrol and you can collect the data from the ‘comfort’ of TAC HQ’. {Military Adviser}

A moment’s silence leads to a moment of clarity, if we were going to get all the information we needed that was the only way it could happen. The ‘Pen’ assured me that despite giving me an excellent grounding in the analysis and the data requirements from the TAC HQ, she just couldn’t put her finger on the data we needed from the patrol. As the data needed from the patrol was all observational and dependent on reactions to stimuli from the headquarters, she would recognise it when she saw it. {Military Adviser}

Never having been misled before, I would just have to trust the ‘Pen’ on this one. I set the wheels in motion and created a suitable scenario to allow the ‘Pen’ to take part in the patrol. Having stepped her through some basic equipment training, IMTs and what she could expect, I was comfortable that she would be able to cope. {Military Adviser}

The following morning we grabbed our tools of the trade, me my notebook and pencil, and the ‘Pen’, her webbing, it didn’t feel right, but I just hoped my infantry peers would never find out. {Military Adviser}
The wrap-up:

Having completed the patrol the ‘Pen’ was happy with the data collected and was still in one piece. Having survived the patrol and the patrol members still willing to interact with her, even ready to pose for a picture with the FA/MA team as shown in Figure 2, it was a good outcome. She appeared a little apprehensive about what information I had gathered. I broke the news the information we needed was not where we thought, and I couldn’t get the specific timing data she needed. Before she smacked me over the head with my own notebook I added ‘So I thought with the data from the incident trace I would conduct some interviews and quantify some of the qualitative data that existed. I figured we could match the incident trace with the interviews to give us the same results’. Credit goes to the ‘Pen’ on this one, who ran me through some training and made sure I was involved in the planning process the whole time. Without that training we would have severely reduced our ability to meet the commander’s requirements. {Military Adviser}

The road to hard data

In collecting data, many challenges face the team. The first is a single opportunity to collect the data which can result in incomplete or missed data. Secondly, the fluidity of the free flowing battle, results in a reactionary response by the FA/MA team. Continual transformations in the battle require the team to apply flexible techniques in a timely fashion. Finally standardisation of the data collection process requires techniques that can be employed by any team member, allowing quality control in the collection process and further adding confidence in the results. These factors all contribute to a trade-off in scientific rigour with data available for collection by the team in an adverse environment. The team needs to attend to the science associated with the study objectives as well as the context of the battle. Without considering both, the results
are degraded. The ‘Pen’ and the ‘Sword’ become dependent on each other’s competencies. Without each other’s strengths, the results lack integrity, but together their individual and team uniqueness provides timely and credible advice to Defence.

There are two core strategies for collecting data in a military field environment: the ability to observe and record in an unbiased way what you see, not what you think you see, and to communicate effectively to elicit information from military participants. While simple in concept these are difficult in reality to execute.

**Untangling the story – Facilitation and debriefing**

To untangle the story, the FA/MA team gathers information from participants of all ranks either individually or as a team with reference to a specific activity. Strategies for this data collection process loosely base its interactions on Critical Decision Making (CDM) processes. CDM is a semi-structured interviewing technique used to extract knowledge from experts on their decision-making processes. The technique allows for the shift from an overall operational account of an incident to a description of the problem-solving processes during the incident. Essentially the participant is asked to provide a general description of the incident followed by a more detailed account of the sequence of events that occurred. The FA/MA team facilitator and participant then establish a timeline for the incident and identify the critical points at which decisions were required. Following that, the facilitator uses a number of probes to elicit more detailed information from the participant about the problem-solving processes at each of these points.

Figure 3 shows members of a clearing patrol being debriefed by the FA/MA team during the test case scenario. The FA/MA team broadly used the CDM process and loosely-based probe...
questions about personnel, organisation, sustainment, training, equipment and doctrine to represent capability as a whole and how, what, when, where and why were a useful first interaction with patrol members. For this example a map was used to elicit key decision points by the patrol commander (as illustrated in Figure 3). The patrol commander, second from the left in the picture, is referring to a map. Here the frames of reference were decision points arrived at geographically and events rather than time. The key decisions and information pertaining to those decisions was a reference base for this debriefing process. The FA/MA team considered this to be a very powerful tool for gathering information from the patrol group rather than with individual patrol members. It also allowed for validation and investigation of anomalies in the information by the FA/MA team as the debriefing process progressed. All patrol members indicated they felt part of this debrief process. Each member provided their opinion at each of the decision points. Some points for consideration during the patrol debrief included the use of a hierarchy of the patrol members, their relative expertise and their time taken away from other activities. It was important to relate this discussion to the individual’s role within the patrol, allowing them to speak with authority relative to a specific subject area.

Interactions between the FA/MA team members and the patrol members were a critical aspect to the success of this type of data collection activity. The way in which the FA/MA team approached and interacted with the patrol was critical to its acceptance by the patrol members. The FA elicited information more freely from the patrol compared with the MA, who received the doctrinal response, even though patrol members were at ease with both members of the team. The team’s planning process resulted in a general list of questions. However, even with this preparation, the FA/MA team was and must be flexible enough to adjust to changes in the types and amount of information sought. It was important the patrol saw the FA/MA team working as a team, interacting with each other in an easy and professional manner. Key considerations include:

- A requirement for clearly defined roles and responsibilities in the preparation for such an activity, but crucially the requirement for clearly defined areas of responsibility during the conduct of the activity.
- The use of the MA to conduct the ‘introduction’ appeared to gain the confidence of the military participants for an analytical debriefing process. During the debriefing process, the use of the MA in conducting the general briefing functions and note taking allowed the analyst to focus on the key task of facilitating the process for obtaining relevant data.
- Although two of the section members were familiar with this process, the remainder of the section adapted rapidly.
- During the debriefing process, the MA felt uncomfortable in conducting the analytical debrief as the primary facilitator. The MA was not familiar with this specific debriefing process, having been already indoctrinated in a military debriefing process, which may not allow the analytical outcomes to be reached.
- The MA was not able to elicit the detail and ease of response from the military participants as they were subordinate in rank to the MA. The MA should be used to supplement and support the FA in achieving the required outcomes. This will only be effective if both the FA and MA have a clear understanding of these outcomes and the
methods utilised to achieve them. Although one would expect ‘command’ by the MA in the military environment, the MA must be willing to take a back seat and support the analyst in an analytical setting.

Look and see – Observation

Observing activities provides information on what actually happens rather than relying on participants’ perception of what has occurred. Formally observing and categorising actions allows team members to gather information on what is happening and in what sequence the actions are occurring.\textsuperscript{14}

The FA/MA team used both members effectively and efficiently for observation. Understanding of specific data collection requirements from observations by both team members provides team flexibility and efficiency. Sometimes the MA was able to elicit relevant information more efficiently than the FA, especially when armed with unambiguous understanding of the information requirements, allowing follow up if the information was not readily available as anticipated. It is likely the analyst alone would have gathered extra information that was not directly pertinent to these objectives. When observing, the MA may tend to record doctrinal observations rather than what they are actually viewing, especially without specific guidance. There is a balance between recording too much information and meeting the data requirements for objectives.

Strategies for recording observations include a time/event log. The log includes recording of events within a specific activity with a time stamp as reference. It is useful to have some standard coding practice for specific actions or activities and their context. The observation processes can quickly become overwhelming; therefore it is useful to have some boundaries physically and analytically to focus the data capture process. Recording the context about the state of the battle is an essential ingredient for all observations.

Follow the yellow brick road – Incident traces

Incident traces follow an event or some form of information or hardware across boundaries. These boundaries can be command levels, functional areas within headquarters, physical location or a combination. Incident traces use a blend of observation and debriefing processes as described in the previous sections. Data often includes timing and formal aspects of military processes. Examples include operations logs, radio logs, specific messages and orders. This technique allows the collection of supporting hard data to achieve study outcomes. Using the test case for reference, key points include:

- The MA can quickly locate the required information with minimal impact on the unit due to previous analytic training and direction provided by the analyst and utilising their military knowledge base.
- The MA was familiar with the types of military processes used within the headquarters environment, enabling efficient data collection. The MA could capitalise on moments of opportunity with personnel in the headquarters during this collection process. The FA has less expertise in the military context which could result in the collection of unnecessary data.
• From training, the MA was able to identify the additional requirement for interviews to supplement the collection of raw message data. The quantitative data collected as messages provides an overall picture to support the completion of the incident trace.

**Bring it all together – Collation and analysis**

Collating and analysing data can be achieved through a myriad of analytical techniques, the detailed description of which is outside the scope of this article. Such techniques are comprehensively presented in Coyle’s *Practical Strategy: Structured Tools and Techniques* and Rees and Bowden’s *System Instantiation Comparison Method: A Technique for Comparing Military Headquarters*.15 The analyst has developed several hybrid strategies designed to support the FA/MA team specifically for field activities16 with ill defined study objectives. These strategies have been used by the international Armies Program which informs coalition activities, military field exercises, ADF capability development and operational deployments. The key is keeping the strategies uncomplicated and measurable with respect to the problem space under consideration. The techniques could include hybrid process mapping techniques, incorporating timing and specific system representation allowing capability information to be represented, incident traces information through the system informing empirical results or system representations. Discussions, interviews, and observations result in large amounts of descriptive data. Thematic analysis strategies17 develop qualitative results to support the study objectives. Support tools can extend from simple office suite configurations such as Excel and PowerPoint to the high end simulation and statistics packages.

Do not make it more complicated than it needs to be; in field data collection and analysis, as in operational situations, even the simplest things can be increasingly difficult.

**Summary**

When a gifted team dedicates itself to unselfish ‘trust’ and combines instinct with boldness and effort, it is ready to climb.

Patanjali

Many hours later we finished peering over our data to collate and analyse all the findings from the exercise, and developed a briefing package for the commander of the results. As we both sighed with relief I turned to my colleague and indicated: ‘This will require military brevity. I got us in, you get us out’. {Field Analyst}

With the final briefing concluded and formal goodbyes to the commander over, the ‘Pen’ and ‘Sword’ left the briefing tent for the final time engrossed in conversation about their insights into each other’s diverse abilities and their shared wins as a team. They did not even notice the headquarters was already implementing a number of their key findings. {Field Analyst and Military Adviser}

With an ever-changing battlefield, strategic environment and rapid advances in technology, the ADF increasingly relies on advice from DSTO which is both credible and timely to
keep its edge on the battlefield. This advice can inform policy and actions for Defence on potential vulnerabilities in operations and identifies change through process, organisation or technology. A well-functioning FA/MA team provides a unique credibility to the advice that few other approaches can. Decision makers want timely delivery of workable advice—not perfect solutions that are too late to be useful. The team provides areas of uncertainty in their advice for consideration by the commander. This is where the FA/MA combination adds most strength to the team; the MA assists in interpreting the level of advice that will be useful to the commander, while the FA contributes a selection of approaches to develop the advice. The FA/MA team has limited impact on the unit or activity under study and allows effective and efficient studies providing credible, high-quality, timely results.

Conducting analytical studies successfully in a military field environment is harder than might first be imagined for both members of the team. The test case identified that the challenges for such a team are enormous, including the military environment and clashes of cultures between team members. The diversity in backgrounds of the ‘Pen’ and the ‘Sword’ bring a fundamental strength to the team; it can also be its greatest potential for failure. Differing cultures, the military environment in which to explore a scientific objective, the rigidity of the military ethos and questioning of the scientific method are areas of potential conflict between team members. Without consultation and effective communication, this diversity can negatively impact the team’s ability to function effectively. Each team needs to develop its own strategies to overcome these difficulties, to come together, to keep together and to work together.

A cohesive FA/MA team meets individual and team challenges together. This cohesion lies in the team’s internal integration and external adaptation. The credibility offered by the FA/MA teaming is unique. The distinctiveness of this team is its balance between the use of military knowledge, the ‘Sword’, and analytical techniques, the ‘Pen’, while keeping the integrity of the context under study and the balance with scientific rigour. Unifying disparate backgrounds, clarity of purpose and the rapport built on trust and respect between team members is its edge. In short, it is teamwork grounded in communication and a willingness to meet its challenges together.

This article has provided broad guidance for solving the distinctive challenges facing an FA/MA team. The individuality of each team implies the instruments for success rely on each team member’s active effort. The ‘Pen’ and the ‘Sword’ need to rely on each other. Without each other’s strengths, the results lack integrity—if there are any results at all. Together their individual and team uniqueness provides timely, credible and valuable advice to Defence that few other approaches can match.

This article has provided guiding principles for consideration, but there is no process to follow. It is intended to provide lessons learned to other teams to be applied in their specific situation.
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NOTES


Organisational Efficiency and Effectiveness: Lessons from Computing Theory

Dr Richard Taylor, DSTO

Introduction

Obtaining general performance measures that can be applied to different organisations operating in different environments is notoriously difficult. There are several reasons for this. First, these problems are complicated by the large number of factors at play and the web of relationships between them, and the effect of human and social factors on organisational performance can also be difficult to quantify. Second, the understanding of the problem space, as well as the functioning of the organisational engine can change while the plans and actions are being generated.

Computational modelling might provide the tools to better understand the performance of organisational models. This article explores in a fundamental sense the ability to measure such model performance. Thus, while a given computational model can be run with a given input and its performance observed, the ability to gain performance insights across all possible inputs, or against other models performing the same task across those inputs, is subject to theoretical limits. Such limits are rarely discussed in models of organisational performance, so this article explores the nature of these limitations.

Figure 1: Model of organisation presented with an information problem.
The area of investigation is highlighted in Figure 1. This diagram represents the process of using a model of an organisation presented with a task in the form of an information problem. The organisation and task are assessed with a view to modifying the organisation to effect performance improvements.

The value of this investigation in developing a better understanding of command and control (C2) systems comes in two areas. Firstly, through rigorous definitions and the appropriate application of mathematical and computational insights, basic limits of what can be expected from C2 performance measures are made clear. This means that the pursuit of approaches (from hard or soft science) that hope to sweep away these limits undermines efforts to develop effective measures of C2 performance. Within these limitations however, we also develop a framework within which a more detailed understanding of performance measures can be understood and explored in future work. In particular, we highlight that each organisational model has a distinct 'shape' that is defined by the model in conjunction with the variety of inputs to it. In turn, the shape of the organisational model dictates the method by which organisational performance can be measured and the limitations of those methods. So, in the context of C2, valid measures of organisational performance require a clear understanding of the organisational model that best represents the practice of C2.

**Computer programs and organisational models**

Consider an organisation as a number of networked processing units (individuals or groups of individuals) each with a capability of processing inputs and producing outputs according to certain rules. Outputs produced by a unit are directed to other units as inputs. A unit may change its function over time, so, for example, it can pass an output to itself and perform a different function. In this sense an organisation is a computational system and can be modelled as such. We have in mind just such a computational system when we refer to organisational model throughout this article.

Note that an organisation is best considered as a parallel distributed computational mechanism in that the processing units are capable of some level of concurrent or parallel processing. For our purposes it is sufficient to assume that only one processing unit is available. While for practical purposes this would be a gross simplification in the analysis of real organisational questions, it does not have a bearing on the fundamental nature of the results given here.

**Computing results**

What is not well known, outside the communities of research mathematicians and computing theorists, is that problems that are sufficiently wide in scope are known not to have any general solution methods. By this we do not mean that solution methods are yet to be found, but that general methods do not exist. Furthermore, for those problems that do have solution methods, in the overwhelming majority of cases very little is known about the best possible efficiency that any solution method might offer.
Two fundamental results from computing theory are referred to here. We use informal statements of these results that are suitable for our purpose. It is nevertheless important to note that these results are mathematically formalised in the references provided.

The **Halting Problem** can be stated informally as:

Given a computer program and a finite input, determine whether or not the program, when fed the input, terminates (halts) or runs forever.

In what has become recognised as a cornerstone of computing theory Alan Turing proved that:

**Halting Theorem:** There is no method or program that solves the halting problem for all program-input pairs.

At first sight this may seem like a rather narrow conclusion that does not have important implications for interesting or practical problems. It turns out, however, to be the basis of generalisations that have wide ramifications.

A theorem of H.G. Rice that generalises the Halting Theorem can be stated informally as:

**Rice’s Theorem:** There is no universal method or program that determines any non-trivial functional behaviour of computer programs.

An example of a functional question for which Rice’s Theorem applies is ‘does a computer program with input 1 produce any outputs?’ A non-functional question for which Rice’s Theorem does not apply is one that refers to the operation of the computer program such as ‘does a computer program with input 0 produce an output within 1000 steps?’

The Halting Theorem and that of Rice are cornerstones that shall be used or referred to in the main results presented later.

**Multiplication**

In order to better convey notions of efficiency and effectiveness we consider a simple example—that of the multiplication of two integers. Consider the familiar ‘schoolbook’ way of multiplying two integers together, illustrated below.

\[
\begin{array}{c}
345 \\
\times 123 \\
\hline
1035 \\
6900 \\
34500 \\
42435 \\
\end{array}
\]

Notice that this method represents a way of multiplying two numbers no matter how large. In general, if \( n \) and \( m \) are the lengths (number of digits) of the two numbers to be multiplied...
then this method takes about $2nm$ steps to complete (in the example given, 9 single digit multiplications are performed to construct the 3 rows formed by multiplying 345 by each of the digits 1, 2 and 3, and a further 9 steps to sum the three rows constructed). Thus a measure of the efficiency (or formally algorithmic complexity) of this method is about $2nm$ (in a sense one could call this inefficiency in that it increases with poorer performance).

This method shows how to compute the product of two numbers exactly. In many situations it may be sufficient to approximate the answer, and to achieve this with less computational effort. If it is sufficient to compute the product of two numbers to $s$ significant digits, then this can be achieved by multiplying the first $s+1$ significant digits of each number and then adding back an appropriate number of zeros. The algorithmic complexity of this method is therefore about $2(s+1)$. For example if we wish to multiply 35416 by 23871 to 2 significant digits, then $354 \times 238 = 84252$ and so $35416 \times 23871 \approx 84000000$. This illustrates what is a typical compromise between efficiency and effectiveness. The efficiency can often be improved at the cost of reducing the effectiveness, and likewise the effectiveness improved at the cost of efficiency.

**Some formalities**

While this section has been prepared for general readership, the mathematically faint of heart however can choose to skip this section.

The definitions of efficiency and effectiveness provided in this section are relative rather than absolute in nature. Thus, organisations are considered effective or efficient in as much as they perform well in comparison to other organisations performing the same role.

We denote a family of computer programs $P$, called organisational models, each with a corresponding infinite collection of inputs $I$, and outputs $O$. Denote $\text{output}[p,i] \in O$ as the output of the program $p \in P$ when fed the input $i \in I$. We consider all inputs and outputs to be binary strings. Also let $\text{time}[p,i]$ denote the time taken (specifically the number of elementary operations) for the program $p$ to complete processing on input $i$. In the following $\epsilon$ is some fixed small positive constant (less than 1).

**Definition 1:** Let $p$ be an organisational model, with inputs $I$ and outputs $O$. Let $f$ be some growth function over the natural numbers $N$. Then $p$ is said to be $f$-efficient if for any other organisational model $q$ with identical inputs and outputs, so that:

$$\text{output}[p,i] = \text{output}[q,i], \text{ for all } i \in I,$$

then

$$\text{time}[p,i] \leq f(\text{len}[i])\text{time}[q,i], \text{ for all } i \in I.$$

In words, $p$ completes in at most $f(\text{len}[i])$ of the time of any other organisational model that performs the same task.
Definition 2: The function $f$ is non-trivial if for some positive $\varepsilon > 0$

$$f(m) \geq 1 + \varepsilon \text{ for all } m \in \mathbb{N}.$$ 

The following result can be proven using a variation of the Halting Theorem. As far as the author is aware this result is new in that it is outside the scope of Rice’s Theorem.

Theorem 1: There is no universal method or program to determine whether an organisational model is $f$-efficient for non-trivial $f$.

In order to consider the matter of effectiveness we need some notion of the best possible output that an organisational model can generate. One way to do this is to consider a family of problems $R$ and goodness measures as follows. Each problem in $R$ consists of a countably infinite collection of input-output pairs $(i,o)$. For each $r \in R$ and $(i,o) \in r$ we have a goodness measure $g[r,i,o]$ between 0 and 1. This represents the goodness of $o$ as a solution to the problem $r$ with input $i$, with $g[r,i,o] = 1$, meaning that $o$ is an ideal solution to problem $r$ with input $i$. In general we do not assume that each problem input pair $r,i$ has some output $o$ for which $g[r,i,o] = 1$. Thus we cannot always readily recognise best possible solutions. We can now proceed to define an effective organisational model.

Definition 3: Let $r$ be a problem and $p$ an organisational model, with identical inputs $I$ and outputs $O$. Then $p$ is said to be $f$-effective (as a method of solving $r$), if for any other organisational model $q$ with identical inputs and outputs, so that

$$\text{output } [p,i] = \text{output } [q,i], \text{ for all } i \in I,$$

then,

$$\frac{1}{f(\text{len}[i])} g[r,i,\text{output}[p,i]] \geq g[r,i,\text{output}[q,i]], \text{ for all } i \in I$$

In words $p$ is within $1/f(\text{len}[i])$ of the effectiveness of any other organisational model for solving $r$.

The following is a direct result of Rice’s Theorem since it addresses a non-trivial functional question.

Theorem 2: There is no universal method or program to determine whether an organisational model is $f$-effective for non-trivial $f$.

What then can be achieved?

The results of the previous section show that any useful question about the efficiency or effectiveness of an organisational model can have no method, algorithm, or program that generates correct answers for all such models. Thus,

There is no method to find the most efficient or effective organisational model that matches a given collection of requirements (inputs and outputs).
Similarly, there is no method to tell whether a given organisational model is efficient or effective. We stress that this does not mean that the efficiency or effectiveness of any particular organisational model cannot be determined. Rather, this means that whatever method is used may not succeed when applied to another model (and will not succeed for some other models). This implies that the analysis of increasingly complex organisational models ultimately requires new analysis methods, and this process of extending the analysis methods for novel models has no end.

It follows that useful methods that analyse questions of efficiency and effectiveness in organisations must in some way be limited in scope. One approach to this limitation is to restrict the structures allowable when considering organisations so that analytic methods are known to apply. This approach has been applied to the Halting Problem by the development of Termination Analysis. It is worth noting, however, that the basic building blocks of a computing machine are surprisingly simple, and to place restrictions at this level is, we believe, likely to greatly reduce the model diversity beyond what is desirable.

Furthermore, structures that may appear at first sight to be significantly constrained or limited may not turn out to be so. Famously, the multinomial solvability question as to whether an algorithm exists that can determine whether multi-variable polynomial equations over the integers have integer solutions, was posed as early as 1900, but remained open for over 70 years until finally resolved in the negative. Even today this question is unresolved when the polynomial equations have anywhere between 2 and 10 variables.

No speed-ups

One way to ensure that at least some method applies, however inefficient, is to define an organisational question in which a time limit is built in. For example, an organisational performance question can be defined in terms of a finite set of input scenarios, and any organisational model is given an upper limit on the time it can process each scenario. This implies finding a finite number of inputs or scenarios that are in some way representative of the operation of the organisation for all possible inputs. If there are very many or infinitely many possible inputs, this could well be computationally intractable.

Even with this approach, however, there is no way in general of speeding up the analysis apart from simply running the organisational model for the specified time.

From this point on we consider all program inputs and outputs to be bit strings.

Define a function timehalt with arguments \( p, i, \) and \( t \):
\[
\text{timehalt}(p,i,t) = 0 \quad \text{if } \text{p←i} \text{ halts within time } t,
\]
\[
\text{timehalt}(p,i,t) = 1 \quad \text{if } \text{p←i} \text{ does not halt within time } t.
\]

In the following, a program is said to solve a function if it has identical input and output properties. For inputs \( (p,i,t) \) there is an obvious program that solves timehalt within time \( t \) by simply running \( p←i \) and waiting time \( t \). The following result shows that this cannot, in general, be significantly sped up.
**Theorem:** There is no program \( p_{\text{timehalt}}(p,i,t) \) that always solves \( \text{timehalt}(p,i,t) \) in time \( t-\delta \) (where \( \delta \) is some small constant).

Again we stress that this does not mean that the analysis of any particular organisational model cannot be sped up, but that whatever method is used may not speed the analysis of another model (and \textit{will not} speed up the analysis of some other model). Just as Rice’s Theorem generalises the Halting Theorem we can also generalise Theorem 3 to apply to non-trivial functional properties. This is illustrated with a simple example function and the corresponding theorem.\(^{11}\)

Define an ‘output bit counting’ function \( \text{timesum} \) with arguments \( p, i \) and \( t \):

\[
\text{timesum}(p,i,t) = n \text{ if and only if } p \leftarrow i \text{ outputs } n \text{ bits within time } t.
\]

**Theorem:** There is no program \( p_{\text{timesum}}(p,i,t) \) that always solves \( \text{timesum}(p,i,t) \) in time \( t-\delta \).

**Particular models**

An organisation model explicitly refers to a particular problem solving engine but also implicitly to a problem as defined by the outputs required for each input. In this latter sense the efficiency and effectiveness of particular mathematical problems have been studied for many years. Thus the most efficient algorithm is sought that generates certain outputs from certain inputs. Typically it is clear how to obtain the required outputs given sufficient time, so there is a solution method, though it may require an inordinate amount of computation. For the overwhelming majority of these problems, however, it is not certain what the most efficient possible methods are in order to do this. This is not to say that many ingeniously efficient algorithms have not been developed, rather that arguments that rule out the existence of even better algorithms have not been found as yet. Returning to our multiplication example, through the development of more and more sophisticated approaches the multiplication of integers has been solved with increasing efficiency.\(^{12}\)

Results about effectiveness are varied in character, many being in the form of understanding the trade-off between efficiency and effectiveness (see the earlier multiplication example, and the discussion on performance guarantees for approximation algorithms in note 13). Most results of this kind are not known to be the best possible.

**Alignment with practice**

In this section we reflect on efforts to measure the efficiency and effectiveness in organisations, to see how the limitations highlighted in this article might be reflected. In the military area of command and control a significant body of experience is distilled in the NATO Code of Best Practice for C2 Assessment.\(^{14}\) The NATO guide has been produced to ‘facilitate high quality assessment in the area of Command and Control’. It is a guide that decision makers and analysts will use to examine the impact of new information-related capabilities on organisational performance. In the following section quotes from the best practice guide are connected where
possible to related mathematical results given earlier. This shows the relationship between mathematical foundations of efficiency and effectiveness and the expert judgements from which the best practice standards were developed. It also shows where the mathematical understanding of the problem might be used to better inform expert judgement.

C2 issues have long been regarded as difficult to analyse. Many operational analysis studies have simply assumed perfect C2 in order to focus on other variables [page 5].

No single measure or methodology exists that satisfactorily assesses the overall effectiveness of C2 [page 89].

This is reflected in Theorems 1 and 2. Indeed these show that no methodology exists in the strong sense that it can never be found, rather than simply being unknown to researchers at this time.

If done well measures of C2 effectiveness will be scenario independent so one can compare C2 effectiveness across a range of missions and circumstances [page 96].

Theorem 2 indicates that this can never be fully achieved (across all possible missions and circumstances). Now Theorems 1 and 2 tell us that any fixed method will fail to correctly assess some organisational models and inputs. The regularity with which a given method will fail is quantified and pursued in the more technical article. This relates directly to the extent to which a method/measure may be scenario independent, and is the topic of further research by the author.

Variety

An interesting perspective that sums up the results of this article in a wider context is that of variety. The variety within a collection of organisational models and inputs to those models is intimately linked to the efficiency and effectiveness measures that it is possible to obtain by any fixed method. This is illustrated by Table 1. The three rows in this table represent different levels of variety in the organisational models and their inputs, while the two columns to the right provide analogues and examples from the spheres of mathematical computing and organisation science respectively. The organisational science elements are drawn from the sense-making domains developed by Kurtz and Snowden, and we believe these are readily applicable to C2.15

Finite: For a finite collection of organisational models and inputs to those models, it is possible, at least in principle, to run all the models with all the inputs and to tabulate the outputs produced, the time with which they are produced, and their corresponding effectiveness (assuming a computable effectiveness measure is available and upper bounds on meaningful run times apply). Once produced this table represents a complete measure of the efficiency and effectiveness of those models with respect to the inputs. The table also embodies a highly efficient solution method in its own right, since solutions can be simply looked up. Mathematical examples are that of 12 times multiplication, books of log tables, and handbooks of indefinite integral types. Of course, in practice, if the number of models and inputs is large,
the table produced may not be constructible with realistic memory or time resources. In this situation, solutions must be obtained based on the application of computational methods, and in this regard needs to be treated like an infinite model/input collection. This is analogous to the ‘known’ domain. The decision model here is to sense incoming data, categorise the data and respond according to predetermined practice. Here cause and effect are linear, and best practice operates well.

<table>
<thead>
<tr>
<th>Collection of Organisational Models &amp; Inputs</th>
<th>Examples from Mathematical Computing</th>
<th>Analogues from Organisational Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finite -</td>
<td>Tables</td>
<td>THE KNOWN</td>
</tr>
<tr>
<td>Can completely and accurately assess</td>
<td>-12 times table</td>
<td>-Legitimate best practice</td>
</tr>
<tr>
<td>performance given sufficient</td>
<td>-log tables</td>
<td>-Standard Operating Procedures</td>
</tr>
<tr>
<td>time</td>
<td>-table of integrals</td>
<td>Sense-Categorise-Respond</td>
</tr>
<tr>
<td>Infinite – Limited/Bounded Variety</td>
<td>-multiplication</td>
<td>KNOWABLE</td>
</tr>
<tr>
<td>Can always successfully assess within</td>
<td>-scheduling</td>
<td>-Analytical/reductionist</td>
</tr>
<tr>
<td>certain bounds. However the gap between</td>
<td>-sorting</td>
<td>-Scenario planning</td>
</tr>
<tr>
<td>lower and upper bounds is almost always</td>
<td>-routing</td>
<td>-Systems thinking</td>
</tr>
<tr>
<td>significant.</td>
<td></td>
<td>Sense-Analyse-Respond</td>
</tr>
<tr>
<td>Infinite – Wide/Unbounded variety</td>
<td>-halting problem</td>
<td>COMPLEX</td>
</tr>
<tr>
<td>Any assessment method must fail for some</td>
<td>-multinomial solvability</td>
<td>-Retrospective coherence</td>
</tr>
<tr>
<td>pairs of Organisation/Info problem pairs.</td>
<td></td>
<td>-Pattern management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>-Perspective filters</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Probe-Sense-Respond</td>
</tr>
</tbody>
</table>

Table 1: Levels of variety, examples and analogues.
Infinite – Limited/Bounded Variety: For infinite collections of organisational models and inputs there is a critical level of variety in the structure of models and their inputs within which solutions can always be obtained within known efficiency and effectiveness bounds by some method, and beyond which no such method exists. In the table we refer to this critical level as bounded variety, and it contains particular problems (or finite collections of them) referred to in the previous section. In mathematics the multiplication of any two integers fits within this domain. All manner of optimal solutions to scheduling, sorting and routing problems are also of this type. This is analogous to the ‘knowable’ domain. In this domain experiment, expert opinion, fact finding, and scenario planning are appropriate. This is the domain of methodology, which seeks to identify cause and effect relationships through the study of properties that appear to be associated with qualities. The decision model here is to sense incoming data, analyse that data and respond in accordance with the interpretation of that analysis.

Infinite – Wide/Unbounded variety: Finally, for infinite collections not of bounded variety, which we call unbounded variety, solutions cannot be reliably obtained by any fixed method. Examples from mathematics and computing theory are the halting problem, and the multinomial solvability problem. This is analogous to the ‘complex’ domain. In this domain emergent patterns can be perceived in retrospect, but not predicted. Structured approaches that codify such patterns will confront new patterns for which they are ill prepared. Understanding in this space requires us to strive for multiple perspectives on the system. The decision model here is to create probes to make patterns more visible, sense those patterns and stabilise those found to be desirable.

Summary

In summary, the results of this article highlight the limitations of any general methods of organisational analysis—specifically regarding questions of efficiency or effectiveness. In particular, they also emphasise the importance of understanding the level of variety in the problem space, and the indispensability of modelling and simulation in this context.

Richard Taylor graduated from the University of Melbourne with a Ph.D in mathematics in 1987. He joined Telstra Research Laboratories in 1988, working on networking reliability, and secure communications. In 1994 Richard joined the Defence Science and Technology Organisation (DSTO), and currently heads the Joint Headquarters Analysis discipline within the Joint Operations Division. His research interests include command and control, computational complexity, prediction theory, and networks.
NOTES

1. The NATO SAS-050 report on C2 identifies over 300 variables.


4. A property of partial functions is *trivial* if it holds for all partial computable functions or for none.


17. ibid.

18. ibid.

19. ibid.
Objective Soraken Peninsula

Mervyn Hill

Department of Veterans’ Affairs 2008 Veteran Community Story Writing and Art Competition – Winner of the ‘True War Experience’ Australian Defence Force Journal prize

Bougainville; March 1945: it was early morning and enemy shells were landing and exploding just ahead of the platoon. The Platoon Commander called a stop and told me (the signaller attached to the platoon), to connect the phone to the cable I was laying. He then made a phone call to Tactical Headquarters (Tac HQ) advising them of the situation. They replied to suspend patrolling and dig in until the shelling stopped. Later that afternoon a patrol was sent out and came under intense fire from the enemy; two Japanese were killed and we suffered two men slightly wounded. The Japanese then mortar-bombed our position, we replied with our two inch mortars but during the battle one bomb hit a tree above our heads. The explosion killed two of our troops and the fellow beside me had a piece of shrapnel go through his boot and cut off the top of his big toe. I felt a whack and a stinging sensation in the small of my back. It was a piece of shrapnel the size of a peppercorn lodged under the skin, which had come through my webbing belt. I was able to dig it out with my fingernail.

Next day it was decided the platoon would advance along a well-used Japanese track that a patrol discovered the day before. Progress was very slow along this track as the enemy could attack from in front or behind. I pointed out to the OC [Officer Commanding] that the yellow Japanese signal wire running along the track hadn’t been laid long as it was still a bright yellow colour. It was getting late in the afternoon so the OC decided to dig in and set up a perimeter beside the track. Fire lanes were set up and both entrances of the track covered by the Bren gunners and the usual booby traps put in place. There was no enemy activity in our position but Japanese artillery could be heard exploding in an area where another company of our Battalion was operating. Just before dusk I decided to tap my phone into the yellow phone line to see if it was being used. A little while later the phone rang. I picked up the receiver and I could hear two Japanese having a conversation. I quickly replaced the handset so as not to alert the enemy that we were in the vicinity. Discussing the situation with the OC I suggested I could tap into this line and have it connected back to Tac HQ, and if they could get an interpreter, they may be able to get some vital information. The OC then rang Tac HQ to tell them of the plan, and after some time they rang back to say that they were able to locate an American/Japanese from Base HQ and all would be arranged for the next day. This was not to be an easy job as the system of using field phones requires only one cable to be laid, and a short wire from a phone attached to a steel stake driven into the ground to complete the circuit. This has its problems because of induction; which means if another of our companies or our artillery were using their phones, they could be heard faintly on the line which could alert the Japanese. When all of our lines were cleared and the interpreter was installed at Tac HQ I tapped my phone into the Japanese cable, and not long after it rang, indicating the line was being used. Later that night we were advised the interpreter learned some information of importance and that the Japanese were very worried about a large patrol that was missing. What they didn’t know was our A Company had ambushed this patrol and killed all of them.
We received a message from Tac HQ that the enemy was in strength on the knoll ahead of our platoon, and for us to stay dug in and take cover while our artillery pounded the area with their 25 pounders and also, the heavy mortars would give them a bit of curry before we would be sent in to clear the enemy from their well-protected pillboxes.

Shell after shell from our artillery whistled over our heads and exploded on the knoll scarring the trees with shrapnel. We hoped they would do the job on the knoll for us and not fall short on our position. The mortars were also very effective in clearing the foliage from the trees and exposing the Japanese bunkers, which would help our assault on their position.

A short while after the shelling finished my phone rang. I handed it to the Platoon Commander who received a message from Tac HQ to prepare for the attack on the knoll. We were told that if we dislodged the enemy from this position the Battalion would have control of all the high ground leading to the Soraken Peninsula.

After the bombardment finished two of our platoons attacked from different directions, but because of the strength of the opposition and a forward scout killed and two men wounded, we were told to withdraw. The Japanese then attacked our perimeter with small arms and grenades but after intense fire from both sides they were beaten off. The heavy mortars were then called on to give the knoll another pounding. The next day our patrol reported a dead Japanese soldier just outside our perimeter and there appeared to be less enemy activity on the knoll. A decision was then made to attack later that afternoon.

As we started to ascend the steep slopes, a burst of machine gun fire came from higher up, so everybody took cover behind logs and trees. The OC then sent a Bren gunner and one rifleman to approach from each flank. When the rest of the platoon were in position they were told to keep the enemy engaged while the Bren gunners crawled to a position where they could get a ‘bead’ on the enemy. The Japanese in their pillboxes and trench system had command of all approaches and were able to roll grenades down on the approaching platoons. After a lot of rifle fire and grenade throwing between the platoon and the enemy, their machine gun ceased firing and only small arms fire was coming from them. This gave the rest of the platoon the opportunity to attack. One soldier crawled up close to their position firing his Owen gun until he got close enough to toss grenades into a bunker; he killed three Japanese. This soldier was awarded a Military Medal for his bravery.

After overtaking the Japanese position we found the enemy machine gunner dead (he had been taken out by one of the Bren gunners) and seven rifleman dead in their foxholes. Our casualties were two killed and three badly wounded men, who had to be carried back to base. As well as capturing the knoll there was a Juki machine gun, many rifles, a field phone and we recovered two Australian rifles. I was very interested in the Japanese field phone, it being half the size of mine and much lighter.

There was a lot of equipment and military documents left in foxholes indicating a hasty retreat by probably about 30 enemy. After he was satisfied we were clear of the enemy, the OC selected a position further along the ridge and told us to form a perimeter and dig in.

When a mate and I were digging in we cut through the roots of a large Lawyer vine that was growing up into a tree near our weapon pit. We noticed there was clear liquid dripping from
the severed root. One fellow (a Queenslander) told us if we became desperate for water we
could drink it. We put our pannikins under to catch the drips and collected nearly a pint. We
were reluctant to drink the liquid and used it to clean our eating utensils; by doing so it saved
a trip down to the creek for water. For the three days we were on the hill, the Japanese shelled
us in the morning and then again late at night without doing any damage. We could hear the
shells whistling overhead and then exploding harmlessly behind us.

After each shelling we dug our trenches a little deeper and fortunately were not dislodged
from this position.

News came to us that two islands (Saposa and Taioff) off the coast of the peninsula had been
cleared of all enemy. The Japanese artillery that was captured had been shelling our troops
who were advancing along the coast.

Patrols from our perimeter reported very little activity in the area, which meant the enemy had
withdrawn a considerable distance; probably to reorganise. I was glad not to be part of these
patrols; carrying a field phone, Owen machine gun and running out phone cable was hard
work on flat territory let alone having to negotiate steep descents. Troops on patrols liked to
have a Sig [Signalman] with them as they would be in contact with the Platoon Commander
for directions or call for help if needed. Sigs were always concerned that the cable could
be cut behind by the Japanese and an ambush set up at the cut. This had happened to me
previously—one of the times the forward scout came under fire and was wounded. The patrol
then had to fight its way out of the ambush; fortunately no one was killed but we did suffer
two wounded. Next day a stronger patrol went back to where the cut was and found that the
enemy had fled and I was able to join the cable and restore communications.

The day we left the knoll it was raining heavily and I think we slipped most of the way down.
At the bottom was a very open swampy area, the water sometimes waist deep. As there was no
cover in the swamp the OC decided it would be a good time to cross as the rain made visibility
difficult and also covered any noise we made. The crossing was made without incident and on
reaching slightly higher ground we headed in the direction of the Sorakan Peninsula. Again
we passed through more soggy areas and on reaching higher ground the forward scouts sent
a message back to take cover while they checked out several thatched huts. They reported
that the huts were deserted and, judging by office equipment and medical supplies, it must
have been a headquarters that the Japanese evacuated in a hurry.

We then followed a well-used track and late in the afternoon we left the track and did what
we called a ‘scrub bash’ through intense jungle undergrowth until we came to a suitable area
where we were told to dig trenches to spend the night. There were quite a lot of banana trees
in this area so I selected a spot between a couple of the trees and dug a trench about a foot
deep sloping down to where my feet would be. At the feet end I dug a sump so the water
would drain into it and help keep my body dry.

It was still raining so I got a bright idea and speared several banana tree leaves over the trench
to help ward off the rain; this was reasonably successful as I was able to get some sleep even
though my boots were wet and soggy.
About midnight the rain stopped and I could see patches of clear sky. Next morning when we were on the move again, the sun filtered through the canopy over our heads and there was a mist rising through the jungle, creating an eerie feeling. The humidity was extremely high and after travelling for about a half hour we came to a little creek. The water was lovely and cool so we rinsed our stinking shirts, took boots and socks off and bathed our feet. Several of us found the skin had gone white and chunks of skin peeled off. We did not drink from the creek as a sign a little way back stated ‘eleven Japs buried here’. The Battalion we relieved would have killed and buried them. The smell of death and rotting vegetation was very bad in this area and made me feel nauseous. The creek was flowing in the right direction and to cover any noise we made, we walked in the water, but after a mile or so the creek turned away from where we were headed. Progress was very slow now as the forward scouts reported that they could see signs of recent enemy activity. The Japanese wore ‘two toed’ boots that left telltale footprints in the sandy soil. The platoon leader was checking his maps to ensure we were heading in the right direction to the coast when all of a sudden a forward scout came scampering back telling us to take cover as there was a party of Japanese heading our way. There were not a lot of trees in this area so we quickly had to scrape trenches in the sand. It was soft sand and I was able to get down about a foot to cover over my upper body but where my backside was, six inches down I struck coral. I thought if I got hit in the buttocks, that wouldn’t be too bad.

I had just placed my phone in front of me for more protection when a burst of enemy machine gun cracked over our heads. We then heard Japanese voices, and some singing out in English ‘Aussie come out and fight’. This suited our Bren gunners as they aimed at the direction of the voices. The enemy rushed our position in suicidal attack after attack but we were able to hold our ground. After this battle, we buried five Japanese and saw a blood trail but did not find any wounded. Our casualties were one killed and three wounded. On finding a suitable position the platoon dug in astride a track and from here extensive patrolling and probing was carried out without contact with the enemy, and on the second day contact was made with another of our platoons. They reported they had killed a Japanese officer who had information about the defence of the Soraken Peninsula. It was also reported that another of the Battalion’s companies had cleared the enemy from the peninsula and all organised resistance had ceased. Our next move was in the direction of the coast. After a short while we came to a river and followed it for quite a distance. At one deep hole, one of the fellows noticed some good sized fish and said they would make a good meal; a grenade was tossed in, it failed to detonate then two more with the same results. One of the grenades was mine and I was glad I didn’t have to use it in a tight situation; maybe the wet and humid conditions of the jungle caused them to be duds.

Tac HQ told us to proceed to the coast beachhead at Soraken where the Battalion would be rested. It was very good news as this campaign had lasted for about 45 days, the Battalion was well down on strength due to casualties and sickness (Malaria, Dysentery etc.) and the troops were in need of new clothing and equipment.

I was returned to HQ Company and was reunited with my Signal Platoon mates who had spent the Soraken campaign attached to various companies. The area where we set up camp was in a coconut plantation right at the edge of the beach and with breezes coming off the ocean, much cooler than the jungle we had left. We were told to dig trenches in case of shelling and patrols would be shared by each of the companies to allow as many troops as possible to rest.
The first week was very enjoyable. We rigged up portable showers using fresh water from little wells that we dug, and were issued with new clothing and boots. Without any activity from the enemy the days were filled with swimming, reading, writing letters and catching up on sleep. One fellow borrowed some of my phone cable to make a fishing line and caught a shark about four feet long. I never found out whether he ate any of it.

The cooks set up a field kitchen about 400 yards back along the beach from our camp, and we were able to go down and have hot meals three times a day. One of my best days while on Bougainville was when a mate and I conned our way on a barge trip to the island of Taioff. The island had recently been cleared of all enemy and the barge party were taking food and supplies over to the islanders. It was a beautiful tropical island, and on landing the islanders greeted us by placing lovely-smelling leis around our necks; we in return were able to give them tobacco and cigarettes.

After the barge had been unloaded the islanders provided us with a luscious tropical fruit lunch but, as all good things come to an end, we reluctantly sailed back to the mainland.

The troops were making the best of the rest period until one day a senior officer (senior in age as well) of our company who did not like the idea of the troops being idle all day, gave an order to clean up around the camp, and to pick up all of the fallen fronds from the coconut trees and put them into a pile. When this was completed he got the bright idea for the pile of fronds to be set on fire. That night the Japanese from one of the islands further up the coast, possibly ranging on the smoke, shelled us.

Next day we were all up early and dug bunkers which would each accommodate three persons. We cut down coconut trees, cutting the trunks into lengths to cover the bunkers. That evening we were shelled again just as several of us had reached the cookhouse for a meal. There was a mad bolt back to the shelter of our bunkers. I looked back a couple of times; the shells were exploding in the water and it seemed as though they were following us along the beach.

The shelling continued from then on, always at evening mess time. The cooks got sick of this and cooked the meal during the day and put it out for anyone who was game enough to go for a meal. Three of us were very glad we covered our bunker with coconut tree logs as a direct hit by a shell from a mountain gun did no damage. After a few days, a routine order from HQ Torokina stated no more coconut trees were to be cut down as this plantation belonged to the Burns Philp company and it would be required by them after the war. This didn’t go down too well with the troops—possible lives for a few miserable coconut trees.

The Soraken campaign cost the Battalion 19 killed in action, four died of wounds and 61 wounded.

Honours and awards included one DSO, one MBE, two MCs, one GM, two MMs and five MID.

The Japanese losses were 167 killed.

George J. Marrett
Naval Institute Press, 2008
ISBN: 978-1-59114-511-0

Reviewed by Air Commodore (Retd) Mark Lax

This new release from Naval Institute Press is a first-hand look at the exciting, yet dangerous world of the air force test pilot flying high performance fighters in the 1960s. Marrett, a graduate of the United States Air Force (USAF) Test Pilot School at Edwards Air Force Base, went on to fly over 40 aircraft types in the halcyon days when records were set and broken. It was a time when the USAF were bringing into service aircraft such as the F-101 Voodoo, the F-104 Starfighter, the F-4C Phantom, the YF-12A Blackbird and the F-111 and it was Marrett’s job to help clear them for Cold War operations.

The book covers the entire gambit of flight test; training including centrifuge training and practicing zero-g in the euphemistically called ‘Vomit Comet’, a converted KC-135 tanker (a technique which is still used today). Next came chase aircraft flying and performance work, and finally attempts to set world speed and altitude records. Autobiographical, the book also includes a chapter on standing nuclear alert over San Francisco as a junior line pilot and mention is also made of his 188 missions over Vietnam flying Skyraiders. These slightly detract from the main theme but an epilogue recounting the careers of fellow pilots who survived rounds off the narrative.

In pushing the edges of the flight envelope of any aircraft, the grim reaper lurks. Most striking for the reader are the number of Marrett’s friends and test pilot associates who were killed in crashes during this period, ‘pushing the envelope’. In fact it becomes a rather depressing read as pilot after pilot die, some under rather terrible circumstances. The first F-111 crash is a case in point (p. 159–61) and the centre photo spread provides a roll of honour. All are friends of the author and all the cream of the USAF. One wonders what effect those losses had on those left behind, and particularly their families.

My only complaint is that the book perhaps overly dwells on the charismatic Colonel Chuck Yeager (acknowledged as the first man to break the sound barrier in level flight), who was the Test Pilot School’s commandant—responsible for graduation standards of a whole generation of test pilots. Only two weeks after Marrett joined the school, Yeager ‘punched out’ of a NF-104, a specially modified fighter designed to set altitude records. The inquiry found pilot
error. The point? On reading the book, you will see how ego and bravado play a big role in a test pilot’s psyche and perhaps that’s just what’s needed.

The hard cover book is 216 pages plus bibliography and index. Sixteen glossy pages of photographs grace the centre section and there are brief endnotes.

This book is not just for budding test pilots. If you are interested in any flying or even if you enjoyed Tom Wolfe’s *The Right Stuff*, then you will certainly enjoy this book. Highly recommended.

**FORGOTTEN ANZACS: The Campaign in Greece, 1941**

Peter Ewer  
Scribe Publications, 2008  
ISBN: 9781921215292

Reviewed by Colonel Chris Field

The author, Peter Ewer, correctly opens this book with the formal definition of ANZAC: Australian and New Zealand Army Corps. In making this point, Ewer notes that ‘ANZAC’ is in fact, ‘an army corps of two or more divisions’. And as the author explains, only twice in history has a ‘real’ ANZAC fought: at Gallipoli in 1915; and, in Greece in 1941.

Sadly, both ANZACs promised much, but ultimately were committed to campaigns which failed in their objectives, which resulted in significant losses for both Australia and New Zealand in personnel and equipment. Peter Ewer’s book develops a powerful narrative of the second ANZAC in a compelling and wide-ranging volume.

In terms of the application of the operational art, the Allied campaign in Greece was a disaster. As Peter Ewer explains:

> At the end of February 1941, Britain and her dominions had in the Middle East the nucleus of a powerful Army, composed of ten divisions. German forces had yet to land in North Africa, the British garrison at Malta stood ready to interdict them if they made an attempt, and the Royal Navy ruled the Mediterranean.

> Three months later, Malta was besieged, Rommel’s *Afrika Korps* stood at the gates of Egypt, the Mediterranean Fleet was battered and bruised by horrendous losses, and the army was in disarray.

The campaign objectives were from the outset of the operation, unclear. Peter Ewer states that ‘there would be later attempts to justify the Greek campaign’ on three grounds:
...first, that the alternative, an advance on Tripoli to clear Libya, could not succeed; second, that the fighting in the Balkans fatally delayed Hitler’s attack on the Soviet Union, and caused the German invasion to fail in the snows of a Russian winter; and, third, that Britain and her dominions were morally obliged to come to the aid of the Greeks, particularly under the watchful gaze of neutral but wealthy America.

With unclear campaign objectives, and a complex Anglo–Greek political environment, it became impossible for the ANZAC leadership, Generals Blamey, Freyberg and Mackay to develop a coherent campaign design. Instead they were forced to deploy units piecemeal employing an unrehearsed, loosely coordinated, and poorly orchestrated plan. Against this campaign construct the ANZACs faced a German Army that had a single campaign vision for both the Balkans and for Greece: Operation *Marita*. Thus while the ANZACs struggled to defend Greece, the Germans used the momentum they had developed through the Balkans, to drive the ANZACs back to North Africa.

At the tactical level, this book provides a stern warning for modern armies, which must continue to: modernise; sustain balanced land forces; train in, as a minimum, a joint environment; and, maintain the flexibility to group and re-group into combined arms teams, from section through to platoon, company, battalion, and brigade levels.

Ignoring or unaware of such stern warnings, the ANZACs in Greece in 1941, comprising the 6th Australian Division and 2nd New Zealand Division, supported by elements of the Greek and British armies, were defeated because the German invaders could:

- fight as an integrated joint force, with strong connections between German ground and air forces for the provision of close air support, the integration of aircraft reconnaissance squadrons in each panzer division, and, in the *Luftwaffe* attacking deep operational objectives such as shipping, port, rail, and road infrastructure; and

- fight as combined arms teams, including rapid regrouping off the line of march, and the novel employment, according to circumstance and terrain, of tanks, armoured vehicles, infantry, artillery and anti-tank weapons. For the Germans, battle grouping (*kampfgruppe*) was standard practice that had proven successful in Poland and France; for the ANZACs, fighting forces did not achieve combined arms effects below Brigade level. Instead Australian, New Zealand, Greek and British infantry battalions, machine gun battalions, gun regiments, and a solitary British tank brigade (the 1st Armoured Brigade), fought alone and unsupported.

Despite the above weaknesses in Australian and New Zealand capabilities, Peter Ewer comments that both the 6th Australian Division and 2nd New Zealand Division were ‘equipped on modern lines’, and were ‘fully motorised formations, with lorries to carry the infantry, and heavy tractors to pull the artillery’. To the uninitiated, it may appear that the Australian and New Zealand forces were therefore well equipped to fight the German Army.

Unfortunately, in 1941, as in 2008, *motorised* formations, that enable the movement of troops and equipment to the fight, should not be confused with *mechanised* formations which enable, and protect, the movement of troops and equipment in the fight. The German land forces, while not fully *mechanised* (‘an anachronistic spear, with a mechanised, 20th century tip and a
19th century horse-drawn shaft) did have the ability, and experience to quickly battle group their mechanised (SdK 251 half-track armoured personnel carrier), armoured assault gun, and armoured (tank) assets against ANZAC, and other, points of weakness. German air-power and combined arms effects soon placed the ANZAC motorised formations in serious peril and led, very quickly, to Allied defeat in Greece.

Apart from motorisation, the author notes that the ANZACs, and other allies, did have modern equipment and technological advantages over the Germans. These advantages included: the ability to intercept German wireless traffic, a strong medical contingent supported by an X-ray machine and dispensary and modern road and bridge repair and minefield laying capabilities, supported by pneumatic tools. The key lesson here is that supporting capabilities, while crucial to an overall battle or campaign, cannot decisively win battles and campaigns. It is only through the orchestration of combined arms teams, well supported by enabling capabilities, that decisive advantage is gained over an adversary.

The author maintains good balance throughout the book, recognising both the Australian and New Zealand preparations, conduct and consequences of the campaign. In many parts of the book Peter Ewer provides excellent and personalised details of tactical actions conducted by Australian and New Zealand soldiers, which are small but significant battles within a larger land campaign. This detail has been gathered, in many cases, through Peter Ewer’s extensive interviews with veterans on both sides of the Tasman.

Key Australian and New Zealand leaders gained significant experience during this campaign, including: Lieutenant General Thomas Blamey; Major General Bernard Freyberg; Major-General Iven Mackay; Brigadier A.S. Allen; Brigadier Cyril Clowes; Brigadier Edmund Herring; Brigadier Sydney Rowell; Brigadier George Vasey; Captain John Collins, RAN; and, Lieutenant Colonel (later Major General) Howard Kippenberger. Following the campaign in Greece, all of these officers continued to serve in the Middle East and New Guinea, except Major General Freyberg and Lieutenant Colonel Kippenberger who led New Zealand forces in the North African and Italian campaigns.

A tabulation of organisational changes, and order of battle tables, for each phase of the campaign would have been useful in this book. This requirement is especially important in this campaign which featured numerous organisational changes on both sides, especially at German battle group level and the ANZAC and Allied brigade level.

Fold-out maps, especially showing the various defensive lines in the campaign (Metaxas Line; Thermopylae Line; Olympus–Aliakmon Line; and, Vermion–Olympus Line), and the operational level movement between opposing forces, including the German airborne operation against Crete, would have also been useful. Of note, all movement in the campaign was not always in the favour of the Axis powers, with the Greek forces conducting a counter-offensive against Italian Divisions in Albania in 1940, which was the first successful land campaign for the Allied cause in the Second World War.

In summary, this book is a useful addition to the professional libraries of Australian Defence Force members who are interested in understanding the challenges of campaigning and the operational art.
RUNNING THE WAR IN IRAQ

Major General Jim Molan
ISBN: 978 0 7322 8781 8

Reviewed by Dr Gregory P. Gilbert

One staff officer jumped right over another staff officer’s back …they were only playing leapfrog, they were only playing leap-frog, when one staff officer jumped right over another staff officer’s back.

Traditional ditty from World War I

Jim Molan’s book, Running the War in Iraq, makes a significant contribution to Australia’s defence by helping us think about our current and future involvement in 21st century conflicts. His practical no non-sense style reflects Molan’s character as a fighting general, but also makes one think about what they would do in similar circumstances. The reader should let their mind venture beneath the surface of this book and envisage themselves in Molan’s place: making life-critical command decisions requiring the application of sound moral judgement and where likely civilian and military casualties are weighed against the desired strategic results.

On the surface Running the War in Iraq is a memoir of Jim Molan’s year-long (April 2004 to April 2005) deployment, including his time as the Chief of Operations in the Multi-National Force–Iraq. But it is more than just another memoir of yet another general in a distant war. Running the War in Iraq is a wake-up call for those Australians who think long and bloody wars of attrition are a thing of the past. While the trenches of World War I (WWI) have been largely replaced by the complex urban and littoral environments of modern war: the essentials of war have not changed: war still involves our community sanctioning our military to kill or disable our enemies. And it remains a decidedly bloody and chaotic activity. One of the major differences between WWI and now is that an efficient modern military staff can understand, run and hopefully win a complex war at the strategic level, in a manner that minimises both civilian and military casualties.

Much of the military intellectual effort on the Western Front during WWI was aimed at the tactical level. Generals wanted more soldiers, machine guns, artillery and by 1918 more tanks and aircraft. Infantry tactics were comprehensively updated until they resembled the squad and platoon tactics that would be familiar to many soldiers of today. Unfortunately, as Molan suggests, ‘Our warfighting tradition in Australia has strengths at the lowest tactical level, but we have failed to keep abreast of conceptual debates and developments about how commanders use forces on a battlefield at the level above tactics.’ (p. 326). This is perhaps the underlying central theme made in Molan’s book—Australia needs to develop generalship or what is otherwise known as the ‘operational art’. Instead of ignoring and disdaining many military staff functions as most Australian soldiers did in WWI, we need to develop a strong
body of strategically minded military leaders who can command and sustain our forces using their professional knowledge and experience. Australia cannot continue to rely upon our allies for military command and logistics and still expect to protect our national interests at home and abroad. ‘In a sovereign democracy, generalship is not something that should ever be left to chance’ (p. 337). It is high time we stopped playing leap-frog.

Molan’s, uniquely Australian, Iraq War experience provides numerous examples of the application of strategic level command. ‘The term “strategic” meant I would be running the level of war that interacted with the new Iraqi government, bringing the political, diplomatic, information, economic and reconstruction sectors into line with the military side’ (p. 132). Whether it was protecting Iraq’s infrastructure, targeting attacks on insurgency leaders, shaping the Second Battle for Fallujah or fighting the way to Iraq’s first free elections, Molan’s experiences are both interesting and thought provoking.

Specific examples include the description of ‘Three Block’ war (pp. 174–175) and the conflation of the levels of war (p. 184), but for the purposes of this review I would like to examine the targeting of individuals. For those who are unfamiliar with military terminology and doctrine, targeting is defined as ‘the process of selecting targets and matching the appropriate response to them taking account of operational requirements and capabilities’ (NATO). In the jargon laden terminology of his actual orders, Molan describes his targeting duties as ‘synchronising diplomatic, information, military and economic elements of power, developing rules of engagement, developing targeting sections of plans and orders, executing time-sensitive targeting and managing attacks against high-value targets’ (p. 134). In Iraq, such strategic targeting often involved directing aircraft to bomb a house, identified by time-sensitive intelligence, as occupied by an enemy leader. The description of how a commander targets individuals from within a secure headquarters (pp. 141–142) and how such actual attacks occur on the ground (pp. 185–187) are particularly illuminating. As usual Molan provides the necessary description in a matter of fact manner while the reader is left to ponder the necessity and actual strategic effects of a military process designed to assassinate a person. Is it better to eliminate Abu Musab al Zarqawi, the head of al Qaeda in Iraq, in a targeted air strike than to let him spread violence and destruction that could kill hundreds if not thousands of innocent Iraqi civilians? If so, what are the strategic effects of cutting off the head of such an organisation, and how are they measured? In some situations the assassination of an Islamist religious leader may increase instability instead of reducing it. Such questions are not isolated to the war in Iraq, rather they are central to how we plan to protect and defend Australia. Such issues are confronting but unless we plan, educate ourselves and train for them we will be caught off-guard.

Many Australians continue to see Iraq as a side-show, as a war of choice, but Molan is quite right to emphasise the importance of the Iraq War to Australia. We are one nation in a globalised world; events remote from our island continent can and do have resounding effects upon our economy and the Australian lifestyle. ‘The values of our society are being challenged by extremist ideas, and at some stage our society must make a stand. …in Iraq I saw evil in a form I had not seen anywhere else, and values that are inimical to everything that has shaped our society since the Enlightenment’ (p. 343). Some may not like the commitment that Molan shows to ‘remain engaged in order to win’ in Iraq, but the narrow-minded, Australia-centric views held by many politicians and officials in Canberra (p. 128) only detract from the debate
over Australia’s support of the Iraqi people, our commitment to help provide international security and to share in the jobs that need to be done as good global citizens. The isolationist image of Australia should have been put to bed long ago.

*Running the War in Iraq* does side-step the debate over the 2003 invasion and here Molan is correct to separate ‘the ongoing war from the emotion surrounding the 2003 invasion’ (p. 46). Before departing, Molan sized-up the situation: ‘the war was being run in accordance with the laws of armed conflict, and that institutionally; military actions were proportional, humane, discriminating and necessary’ (p. 46). But even Molan admits that he did not know much about Iraq before early 2004 (p. 348). This highlights Australia’s embarrassing neglect of the Middle East. For much of our history, Australia has had major strategic interests in the Middle East, much of our trade travels through the critical choke points of the Suez Canal, Bab el Mandeb and the Hormuz strait, our energy supplies comes from the Middle East, and many of our bulk exports are sold to countries in the Middle East. Despite this, the study of Middle Eastern international affairs, culture and languages remains a rarity within Australia. Organisations that specialise in the humanities of the Middle East are few and largely under-funded. How can we ever hope to effectively help Arab peoples, such as the Iraqis, develop their own form of stable democracy if we cannot speak their language or understand their traditions? It is a much more difficult task to understand the ‘diversity and complexity’ (p. 130) of the Iraq insurgency—driven by the extremes of Iraqi nationalists, regional separatists, religious extremists, Islamist terrorists and criminals. General Casey is quoted as saying ‘We are an antibody in this society – they will never like us’ (p. 144). This goes to the crux of the intervention in Iraq for as long as Americans, Australians and other allies remain separate from the society they wish to protect they will never be able to provide adequate security. Only the Iraqis and their allies who understand Iraqi culture can provide long-term security and achieve Iraqi democracy. We do have a role to play, but we need to know much more about how the Middle East works before treading on nations with our size ten boots.

As Chief of Operations, Major General Jim Molan ‘planned and ran a multitude of operations, military and non-military, culminating in the elections (30 January 2005)’. Always acting legally and morally, he ‘gave no cause for our allies to have anything but the highest regard for ADF personnel.’ In recognition of his service, Jim Molan was presented with Ballot Paper No. 9 from the Iraqi election, an honour of which ‘I would never have thought possible … they thought I had played a part in creating an Iraq that had a chance of actually being free’ (pp. 350–352).

This book is well written and a pleasure to read. It should be a mandatory read for those strategists who have tried to dehumanise war and who believe that the Australian Defence Force should place its trust upon a handful of technologically advanced war-winning weapons. It should also be read by Australians who believe that 21st century warfighting can be limited to peacekeeping operations—a bullet can still kill a soldier and a missile can still knock-out its target despite the label that is given to any specific conflict. Molan’s experiences provide valuable insight into the practicalities of modern generalship—they should help to re- emphasise ‘operational art’ within the Australian Defence Force.

*Running the War in Iraq* is highly recommended to the general reader and military specialist alike; each will learn much about 21st century warfare.
This is a good and thought provoking book. It achieves something that is rare in a collection of essays in providing a coherent assessment of its subject. The focus of the volume is to describe and analyse the methods currently utilised to develop an understanding of ethics and ethical behaviour in the military of ten modern democracies. In this, with respect to the countries that are covered, it succeeds admirably and a series of thoughtful and open, although occasionally self-congratulatory, essays are well supported by a comprehensive introductory chapter by the lead co-editor and equally thoughtful concluding pieces by other experts.

If there is a subtext it is the extent to which culture profoundly influences the ethical constructs of different societies and organisations, even if those constructs have been developed with the same intent. There is also a clear sense, particularly apparent in the sections relating to Britain and to Japan, that militaries do not quickly change their constructs or the assumptions on which they are based. The issue here, of course, is the extent to which such conservatism might result in a progressively increasing disconnection from the wider nation which the armed force serves. That, of course, leads to several other key issues which are raised in the book.

One of the most important concerns the tension between aspirational and functional ethics. Which is the more appropriate? Which will serve individuals, armed forces and nations best when personnel face the pressures of difficult moral situations and the need for urgent decisions? How can our people, both commissioned and non-commissioned, be best prepared to do the right thing?

A second concerns the relationship between ethics education and chaplaincy. The extent to which it is led by the Christian chaplaincy in Norway is striking, as is the central position of the Chaplaincy and the focus on Christian virtues in the United Kingdom. In this respect, it would have been enormously valuable for there to have been contributions from more nations which do not derive from Judeo–Christian societies, particularly in the Muslim world. The Japanese approach is certainly profoundly different from that of Europe and the New World and it is all the more thought provoking for being so different.

There are other problems raised and dissected and some hard questions are asked. The Australian contribution to the book is a significant one and it is apparent that the Australian perspective is unique in some ways, notably in the use of case studies of Australian Defence Force events to explore ethical questions, which may deserve further examination by other defence forces. In all, *Ethics Education in the Military* does not attempt to provide a template...
for ethics education but it does cover, very thoroughly, the major issues which face any organisation which must maintain effective mechanisms of education and preparation for real world operations.

Strongly recommended for close and careful reading by military educators.

THREE PASSIONS AND A LUCKY PENNY

An Autobiography by Eric Stephenson,
Air Power Development Centre, Canberra, 2008
ISBN: 9781920800291

Reviewed by Jim Truscott

It is a credit to the Office of Air Force History that they have published this very human account of the life and times of Eric Stephenson whose career commenced as a WWII Lancaster Navigator in the Royal Air Force (RAF) and who finished as the Director General of Air Force Health Services when he retired from the Royal Australian Air Force (RAAF) in 1984.

This is not the tale of a pompous pommy officer; rather it is a rollicking yarn that spans generations through peace and two wars. It is a succession of life experiences and there is something in this book for everyone from Defence wives, through to the former enemy, serious military historians, those interested in Australiana and even Special Forces people like myself. When I first started reading, I flicked through the pictures, some of which immediately drew my attention. As someone who has written my own autobiography I was keen to see how he put it all together. The stories tumble out and some are just all too short.

His accounts of training as a navigator are fairly ordinary but then come the live missions. The stories of deadly battle over Germany before returning to the Officers Mess leave you thinking as to how absolutely frightening these experiences must have been. The human dimension pervades as he proposes to his future wife in between these bombing missions. Sadly his parents did not agree and they indicated that they would not go to the wedding.

Only 14 days after proposing, his Lancaster Bomber was shot down in December 1943. As my uncle who was in the RAAF died in similar circumstances over Germany I could relate to what Stephenson went through. He describes his first night freefall job from his Lancaster which was plummeting out of the sky and the remarkable and subsequently quiet parachute descent while looking down on the flak, before sustaining injuries on landing. Parachutists amongst the book’s readers will relate to this almost religious moment that we all experience after jumping out.

His interrogation experiences at the hands of the Luftwaffe are interesting as indeed are his observations of the ability of his generation to cope with Post Traumatic Stress Disorder. His
guidance on how to survive as a Prisoner of War is very practical and the description belies what clearly was a very difficult two years in captivity until liberated by the Russians.

He then spent ten years as village doctor after the war in private practice; an interesting interlude with a young family in the UK before taking up an offer with the RAAF in Australia. His account of early days at RAAF Base Sale are testament to the families that hooked in together to overcome difficult social situations in remote parts of Australia. As a doctor he describes his transition from disease care in private practice back to health care in looking after fit young men.

The second part of his autobiography describes the pioneering of the Air Force medical evacuation capability which was then put to good use in the Vietnam War. He describes how the RAAF brought home 3,164 men who were injured in some capacity in the back of C130 aircraft, contributing to the recognition of aerospace medicine as a speciality. Not to be outdone Eric and his wife then did some serious backpacking throughout Asia while in their 50’s just as he took on senior positions in the RAAF.

I found the chapter on the changing attitudes and practices towards Air Force health and the realisation at the time that health and fitness were as much an individual responsibility as that of the system to be an interesting reflection and a portent of emerging OHS (Occupational Health and Safety) issues that have challenged the RAAF in very recent times.

After he leaves the RAAF and towards the end of his story he describes how he assists a pregnant Aboriginal lady in the middle of Australia who is in distress to safely give birth some 30 years after his last delivery as a GP. People like Eric Stephenson are the salt of the earth. They are the glue that underpins air combat power and who bring true meaning to *per ardua ad astra*. 
GUIDANCE FOR AUTHORS

The Australian Defence Force Journal seeks articles on a wide range of defence and security matters such as Strategic Studies, Security and International Relations. Normally, articles will only be considered for publication if they are current and have not been published elsewhere. In addition, the Journal does not pay for articles, but a $500 prize is awarded by the Board of Management for the article judged to be the best per edition.

The Layout

Articles need to be submitted electronically and typed in MS Word format without paragraph numbers (essay style). Headings throughout are acceptable. Length should be between 3,500 and 5,500 words (which allows a spread of articles per Journal). Please spell check the document with Australian English before sending.

Articles can contain endnotes, bibliography and brief biography.

Endnotes are required in the style:


References or Bibliography in the style:


Tables, maps and photographs are also acceptable, but must be of high enough quality to reproduce. Photographs must be at least 300 ppi in TIF format and be directly pertinent to the article.

The Review Process

Once an article is submitted, it is reviewed by an independent referee with some knowledge of the subject. Comments from the reviewer are passed via the Managing Editor to the author. Once updated, the article is presented to the Australian Defence Force Journal Board of Management and if accepted, will be published in the next Journal. Be advised, it may take quite a while from submission to print.

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