COMMAND AND CONTROL:

OPERATIONAL EFFECTIVENESS VERSUS TECHNICAL EFFICENCY

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ABSTRACT

This paper explores the impacts of modern technology on operational commanders. It discusses the inter-relationship between time, intelligence reports and communications as components the commander must consider in the application of the art of war. The paper argues that modern warfare technology provides operational commanders unprecedented potential to make timely, wise decisions. The key to unlocking this potential is the commanders' ability to understand the capabilities and limits of those technological tools available to them and their planners. It is the contention of this paper that operational commanders have yet to fully understand the capabilities and limitations of the technological advancements used in the decisions-making process. Therefore, commanders are only capable of performing their duties more efficiently. To achieve the effectiveness offered by technology commanders must understand that Command, Control, Communications and Intelligence (C3I) is a concept that permits the building of a common battle picture from which timely and effective decisions and actions emanate.[1]

INTRODUCTION

Technology continues to help shape the landscape in how nations defend themselves and apply force against an enemy. Most of the changes brought about by technology have focused on increasing the effectiveness and efficiencies to existing equipment. However, every once in a while a change occurs that is so profound that the very nature of warfare is affected. These profound changes are referred to as a Revolution in Military Affairs (RMA). Dr. Elinor Sloan of the Directorate of Strategic Analysis in National Defence Headquarters offers the following definition of RMA by Andrew Marshall, director of the Office of Net Assessments in the Office of the U.S. Secretary of Defense. "A Revolution in Military Affairs is a major change in the nature of warfare brought about by advances in changes in military technology which, combined with dramatic changes in military doctrine and organisational concepts, fundamentally alter the character and conduct of military operations."[2]

As a result of the culmination of the technological advancements in intelligence gathering and communications over the last quarter century, a number of military leaders and theorists believe that the world is in the midst of a major RMA in Command and Control (C2). It is the contention of some that with these advancements commanders will be able to, "see and understand everything on a battlefield" and "if you see the battlefield, you will win the war."[3] Indeed, some technology zealots profess that, "the classic Clausewitzean trinity of primordial violence, chance and probability," will be replaced by, "a new technological trinity: intelligence, surveillance, and reconnaissance

technologies; advanced command and control; and communications and computer systems."[4]

It is proposed by some that the nature of decision-making afforded those who have access to the correct technological tools will ultimately determine the commander's ability to make an informed, rational decision. The modern day operational commander armed with this new trinity of technological wonders will have access to all the information necessary to make wise decisions. The current uncertainties they face in their decision-making will be removed. Tomorrow's commanders, "will move from a situation in which decision-making takes place under 'uncertainty' or in the presence of incomplete and erroneous information, to a situation in which decisions are made with nearly 'perfect' information."[5] Admiral Bill Owens further supports this idea when he stated, "technology could enable U.S. military forces in the future to lift the 'fog of war'…. the ability to see and understand everything on the battlefield – might be possible."[6]

A Canadian Forces Officer, specializing in the field of intelligence, provides a more moderate opinion on the value of technology. He proposed that, "Technology must be viewed in two ways: technology to improve efficiency, or how things are done; and technology to improve effectiveness, which is the process of selecting what things are to be done." He goes on to further explain that the majority of the improvements in (C3I) focused on the efficiency rather than on effectiveness.[7]

This paper will review the impact of technological advancements as they affect Command and Control at the operational level of war. The paper will also explore the role of time in the decision-making process and how the design of new systems accommodate both the ability of the operator to effectively use the new equipment as well as the hostile, dynamic environment found in a theatre of war. An analysis will be conducted on the RMAs impact on two important resources required by the operational commander: intelligence and communications. This paper will make reference to reports and analysis of the Gulf War to provide examples where technology has assisted or hindered the operational commander. Finally, the analysis will demonstrate that operational commanders have yet to unlock the potential effectiveness afforded by technology and have, at best, only become more efficient decision-makers.

TIME AND TECHNOLOGY

There are a variety of definitions of Command and Control. For the purpose of this paper the author intends using the following definition.

> Command gives military commanders the legal authority over personnel and equipment while it is control that provides the commander the ability to place the personnel and equipment into action to achieve desired outcomes.[8]

In order to exercise command and control commanders require three key elements: intelligence information from which to develop plans, the ability to communicate their plans and overarching these two components is the time envelop in which to formulate and activate these plans. The elements of intelligence and communications will be discussed later in this paper. Commanders who can decide on a course of action ahead of their opponents will gain a significant operational and tactical advantage. Therefore, one of the first decisions commanders have to make is when campaign or engagement decisions must be made. The identification of the timing requirements will inevitably force commanders to make decisions regardless of how much uncertainty remains.[9]

The time one has to make decisions will, to a large extent, be based on the speed of one's opponent's decision-making process. Historically, the time required to make decisions has been decreasing and there is no reason to believe that this trend will change. This reality is being driven by major technological advancements in most of the areas of military decision-making model. A common military decision-making model is known as the Observe-Orient-Decide-Act (OODA) loop.[10] Decisions to counter-manoeuvre or take advantage of an evolving situation will be signalled by the latest intelligence reports. As can be seen from Figure 1 the time and command spectrum for the US Forces has been decreasing at all four phases of the OODA loop operational command decision-making process.[11]

TIME AND COMMAND					
	Revolutionary War (1776 – 1783)	U.S. Civil War (1861 – 1865)	World War II (1939 – 1945)	Gulf War (1990 – 1991)	Tomorrow (20??)
Observe	Telescope	Telegraph	Radio/Wire	Near Real Time	Real Time
Orient	Weeks	Days	Hours	Minutes	Continuous
Decide	Months	Weeks	Days	Hours	Immediate
Act	A Season	A month	A week	A day	Hour or less

Figure 1: TIME AND COMMAND

The four stages of the OODA loop - observe, orient and act - are being addressed by continuous doctrinal and technological advancements. However, it would appear that little effort has been expended to enhance a human's ability to rapidly absorb the masses of information to further assist in the reduction of the time it takes to make a decision. An alternate approach to increasing the time a commander has to make a decision is by limiting the enemy's knowledge of events on the battlefield. By denying the enemy access to intelligence data or by providing erroneous data one could dramatically affect the time to make a decision and /or the quality of the decision. This interference with the flow of communications is not a new concept of war and the means of conducting this action ranges from agricultural, cutting telephone lines, to more advanced methods found in Electronic Warfare and Information Warfare.

A classic Gulf War example of this principle was the Battle of Khafji. It was during the Iraqi build up to this battle that the coalition forces became aware of the rigid Iraqi centralized command decision hierarchy and the over reliance of landlines for their C2

network. By eliminating the lines of communications the coalition forces were able to disrupt a complex attack plan that required a great deal of coordination. Therefore once the battle commenced the Iraqi tactical commanders were unable to communicate events to higher command and therefore were left without the direction their doctrine required they have. The coalition forces were able to gain the time to mount counter-attacks resulting in a complete route of the Iraqi forces.[12]

This being said, commanders will be forced out of their comfort zones regardless how much time is available. The key instigator of this discomfort will be the constant flow of data from the myriad of intelligence sources. Information available to the operational commander will be from military as well as non-military sources, each imparting their own spin on the data presented. In the Gulf War, "the air force combined data from sensors, satellites communications, and compartmented information from numerous agencies holding myriad occupational specialities and sometimes conflicting organizational responsibilities."[13] The lack of time to fully assimilate the volumes of data caused commanders to formulate plans and make decisions with what they considered an incomplete understanding of all the factors. This forced the commanders to make plans, "where imperfect information and uncertainty were the rule, not the exception."[14] A question that will be explored later in this paper is, "how much information is enough?"

The culmination of the technological advancements being made in all areas of warfare, from information gathering and processing, accessible at all levels of warfare, and the ability to engage the enemy with precision guided weapons, are some of the integral

components of a warfare system known as, Net-Centric Warfare (NCW). The goal of NCW "is to combine sensors and networking technology with new operational concepts to enable a dramatically improved military sense and respond capability."[15] It is proposed that the components of NCW and the related doctrinal changes continue to fuel the current RMA.

What does NCW bring to the operational commander? Some believe that this ability to manipulate data and link commanders at the operational and tactical levels will provide enhanced efficiency in the deployment of force. " NCW enables smaller, mobile forces to act with disproportionate effect through the use of accurate long-range fires and near real-time sharing of information.[16] To fully employ C2 technology and reduce the risk associated with any decision-making tool it is vital that commanders, at all levels, understand the technological limitations associated with the equipment supporting this capability. Van Creveld provides the following insight, "since a decisive technological advantage is a fairly rare and always temporary phenomenon, victory often depends not so much on having superior technology at hand as on understanding the limits of any given technology, and on finding a way of going around those limitations."[17] This upgrading of systems on both sides of a conflict requires commanders to constantly review the effectiveness and utility of his equipment.

There is little doubt of the critical role technology played in the Gulf War particularly as it pertains to C2. The complexities of modern warfare coupled with the ever-decreasing time to make decisions will require commanders to make quicker, more complex

decisions. For commanders to effectively use technology they must understand each system's capabilities and limitations. Therefore, the decision-making tools selected by the operational commanders to support their missions should be "equipment that allows one to make maximum usage of one's sometimes limited assets."[18]

If sophisticated technology is going to play an increasingly important role in the conduct of war, steps are then required to ensure availability and survivability of the equipment. This concept of "redundancy" is becoming more essential as dependency on technology grows in the efforts to seek further efficiencies in complex, integrated C3I systems. Redundancy refers to both procedural and technical functionality. Procedural redundancy encompasses the ability to carry on with a desired action using an alternate means. When considering technical redundancy both hardware and software systems design must be considered.

In an article referring to the inculcation of RMA within the CF, VAdm. Garnett stated that the implementation process would not "throw the baby out with the bath water."[19] In this article he makes reference to having the ability to take advantage of all the technological improvements offered by the RMA while maintaining the ability to revert to established means, both procedural and technological, to get the task completed. A Gulf War example of the importance of maintaining redundancy surrounds the administrative function of promulgating the daily Air Tasking Order. "The dissemination of the daily Gulf War 300-page Air Tasking Order (ATO) to each service identified numerous system incompatibilities. Despite trying numerous innovative approaches, the

ATO was hand-delivered to each unit ashore and at sea."[20] The impact of not being able to deliver the daily ATO to all concerned would have severely hampered the operational effectiveness of the coalition forces. By having the capability to revert to the hand delivery method of communicating the ATO the effectiveness of the air campaign was maintained; however, the efficiency provided by technology was lost.

A good example of the melding of hardware and software redundancy can be found in the combat systems design found in modern warships. Each piece of critical combat and marine systems equipments has a second unit. Redundant units are physically separated from each other and enjoy alternate wiring systems and power sources. Included in this hardware redundancy is the software redundancy. The theory behind the software redundancy is the development of automatic procedures that prohibit a complete "system crash" should the hardware fail. Instead, the system's software modules, on the detection of system hardware failures, through battle damage or other vagrancies of day to day operations, will automatically reconfigure the software in order to ensure those software functions required to combat the immediate threats remain operational. Non-essential software functions are then shed from the degraded system. This process allows the maintenance of some capability while the system suffers "graceful degradation."

INTELLIGENCE AND COMMUNICATIONS

The advancements in the collection and processing of intelligence data have been immense. The integration of the vast array of data collection systems has resulted in very

complex, technologically dependent intelligence systems. We will now review how these advancements in the quality and quantity of intelligence information affects the operational commander. For the purpose of this paper the following proposed triad will define the components of Command, Control, Communications and Intelligence:

- Data. At the base of the triad, gathered from a variety of sources.

- Systems. Computerized communications, processing, and analytical systems are required to convert data into information and get it to the user in time to be useful.

- Personnel. Well-trained personnel are required to operate and supervise C3I systems. These people must know the overall objectives of the commander so that they can help find and identify essential information.[21]

Operational commanders have to determine how much intelligence data to collect, how large a computerized network will be required to support and analyse that data, and how many people should be assigned to the development and maintenance of the aforementioned C3I components. What factors influence the levels of resources and effort to address these C3I components? Suffice to say, it would depend on the situation including the capabilities of one's enemy and the resources one had access to. Having said this, in the Gulf War the USAF intelligence community established a battlefield data-gathering goal of 90% of all available data.[22] This meant that 90% of all data that

could contribute to the development of the theatre intelligence picture would be collected, analysed and distributed to the operational commanders. It is unclear as to why the figure of 90% goal was selected however there are two possible explanations. One theory proposed by Zimm is, "if some information is good, more must be better."[23]

The other possible explanation surrounds the vast amount of resources dedicated to the intelligence gathering activity making the 90% achievable. In addition to the established methods of collecting data, a new resource for data gathering and processing in the Gulf War was the Joint Surveillance & Target Attack Radar System, (JSTARS). JSTARS was able to scan a 250-mile radius on the ground while staying aloft for eight hours.[24]

The intelligence system collects raw data from the different collection agencies. This data then follows a number of processes that converts the data to information. This includes developing the photographic imagery provided by satellites and aircraft to collecting human reports on the identity and movements of units of interest. This information is then provided to the operator for further analysis. The last step in the intelligence process is the conversion of the information to knowledge by the end user, in this case the operational commander.

However, having this amount of information available possesses new and interesting challenges for the operational commanders. Zimm states that, "unless there is a framework in which to view it, to understand its patterns, and to selectively concentrate on or ignore individual elements, its volume will be debilitating."[25] By using a

framework commanders are capable of performing that vital function of translating information to usable knowledge. This translation process can only be achieved by means of the cognitive process. It is during this process that humans add meaning through analysis, evaluation and integration. This ability to add meaning is solely a function of the human intellect that can only be assisted by technology.[26] It is only once this cognitive function is performed that the real value of intelligence gathered can be assessed.

The capacity for humans to perform the translation process from information to knowledge is finite and it is bound by the time available for a decision to be made. Therefore, the first step in determining how much one needs to know is an understanding of what one needs to know. This is one of the most difficult challenges facing operational commanders.[27] In order to make this determination commanders require a clear understanding of the strategic goals and must be highly trained and experienced. Until we see the development of artificial intelligence, the "deciding" factor in the OODA loop will remain the sole responsibility of the commander.

Even with the a clear understanding of the strategic goals and having the required professional training and experience, operational commanders, being human, still run the risk of being seduced from the quest for the right information. The plethora of information can be sorted into three main categories. That which is clearly not related to the current operation, that which is and that which is exciting or interesting. While most operational commanders have access to a myriad of different intelligence information,

"the successful ones will be those who are best able to sort the important from the interesting."[28]

The ability of the commander to communicate clearly with subordinates and seniors is an important operational capability. As with intelligence, operational commanders are required to make an assessment as to the amount and type of communications support required for the campaign. To assist in filling the communications requirements technology has permitted modern forces to field communication devises of all sizes, shapes and capabilities that cover the complete frequency spectrum. The Gulf War coalition forces used in excess of 35,000 frequencies in order to provide an interference free battlefield. Whether that number of frequencies was really required for this war is open for further debate and research. To manage this enormous task a special office was established for the sole task of frequency management.[29] This example further supports the premise that while technology provides the capability, the effectiveness potential can only be realised through human intervention.

In a report on the lessons learned from the Gulf War, the British cited the example where the communications requirements and use was so voluminous that the C3I net was in constant danger of being overloaded. The British proclaimed that from their experience demand would always fill the capacity provided. Given this proclamation one could conclude that there will never be sufficient number of radio frequencies to address the battlefield communication requirements.[30] The existence of the U.S. program "Constant Source", where fighter wings and tactical ground units can, via small UHF receivers, tap

into the data collected on board orbiting satellites lends credence to the aforementioned British observation.[31] This capability begs the question, "just because we can do we need to?" Therefore, while technology will continue to develop more capable communications equipment it is essential for operational commanders to realise the human resource bill associated with these improvements and attempt to enforce restraint in the use of communications equipment and limit access to different circuits and frequencies.

Another communications challenge faced by the coalition commander was the, "very wide range of communications equipment fielded by the various Allies, and the different communications security systems."[32] The fact that the Iraqi forces were so patient so as to allow the coalition forces time to prepare a combat operation, "saved the coalition from the potential radio frequency bedlam …"[33] In addition to the variety and profusion of radio systems and frequencies was the blatant disregard throughout the coalition forces for the chain of command as it pertains to communication protocols. An example of this was the unauthorised uses of the STU III secure telephone in the Gulf War theatre. "STU III telephone made possible all sorts of exchanges – unknown and unauthorised by senior leaders – between operators and planners both in the theatre and in North America. This modern communications technology both facilitated central direction of the air campaign and undermined its practice."[34] As a result of this eclectic mix of communications systems no commander had a complete C3I picture. Therefore, all commanders were disadvantaged by the apparent lack of communications discipline.

TECHNOLOGY AND THE DECISIONS-MAKING PROCESS

So far this paper has discussed the RMA and the impacts it has had on the types of systems affecting the commander's ability to perform his duties. As well the paper has focused on the advantages and challenges facing modern commanders in the distillation of information from the growing sources and volume of intelligence data and the ability to operate in a complex communications environment. The paper will now look what possible impacts the technical enhancements in intelligence and communication will have on the commander's decision-making ability.

The initial step in the OODA loop is observation. This is where the commanders' teams collect the data provided by the vast array of intelligence sources and distil the data down to information that is relevant to the mission. This is followed by the orientation to the developing events on the battlefield requiring a decision. The commanders continue the processing of the information until they have the knowledge on which to make a decision or act. There are some who advocate the requirement to dominate the information medium, as this will provide "perfect information" therefore permitting the commander to make "wise decisions." If one is to consider information as the final product rather than an end to a means it may place the commander in the undesirable position of "paralysis by analysis." It is important to remember that, "information is not so much a medium to be dominated as it is an input that initiates the process that provides structure to actions."[35] The following paragraphs will demonstrate that the ability of the commander to make "wise decisions" is predicated on more than information dominance.

When confronted with the voluminous, constant flow of intelligence information the first thing commanders have to do is to decide what is the information they require. The ability to make this type of decision is not predicated on the vast amounts of data or the ability to communicate with everyone in the world but by the professional knowledge and experience the commanders have obtained throughout their careers.[36] This professional knowledge and experience not only facilitates the understanding of what intelligence is required but also allows the commanders to develop that sixth sense or "gut feel" interpretation of the clinically processed intelligence information. This sixth sense will permit the commanders to link certain aspects of the intelligence reports together that less experienced or professionally trained personnel are incapable of doing.

The access to almost unlimited intelligence data provides an interesting challenge for operational commanders. As the battle proceeds and plans are formulated there may be a tendency for commanders and staff to "situate the appreciation." What is meant by this statement is that given enough time and access to information one could always continue to research the vast amounts of data until one finds supporting information for any plan. This challenge underscores the requirements not only for the commander to have the correct amount of professional knowledge and experience but to have developed the ability to conduct, "critical analysis and evaluation of information search results."[37]

The intelligence information provided in the modern technologically enriched battlefield allows commanders the opportunities to make the best decisions. Commanders must be

aware of the risks associated with becoming too dependent on hard facts on which to base their decision. Over reliance on hard facts becomes, "the enemy of hunches, eventually suppressing new perspectives on a situation."[38] Commanders must step back and maintain a broader picture of the overall battlefield. Not only will this permit commanders to recognise initiatives and options not afforded by intelligence reports but provides a better sense of the time a decision is required and the degree of risk acceptable for the plan being developed. Commanders have to be on the constant alert not to get so seduced by the trappings of technology that they run the risk of becoming warriors that are, "…so insecure without their computer models and decision systems that they could not step beyond them".[39]

In order to be effective purveyors of force, commanders must be effective managers of risk. There is an impression that the wealth of information available will not only reduce the risks associated with decision-making but also eliminate any risk. If this is to be believed, then the commander's ability to apply professional knowledge and intuition may become a casualty of this risk aversive tendency. Paul Harig, author of "The Digital Commander" provides this observation on risk.

> I doubt that the best microchip will ever exceed the value of 'Kentucky Windage' in decision making, but the illusion of omniscience from multi-sensory information systems might make our leaders fear the 'guesstimate,' preferring to avoid risking mistakes by substituting certainty models for their solutions.[40]

The successful inculcation of C2 technology into an organisation is essential if one is to maximize the capabilities of the new decision-making tools. The magnitude of the impact of the new C2 technology cannot be understated. It will drastically change how one looks at war in the future. In addition to dealing with the constant changes in "Knobology" (the ability to operate equipment), commanders will have to change how they communicate and think. In the Information Age change can only happen if one changes one's conceptual behaviour.[41] Commanders will be required not only to focus on the immediate information from the C3I data required to formulate plans but must be able to, "seek related patterns in unrelated objects, situations, and events."

the events of the Gulf War Mark Mandeles concludes that, "neither the planning staff or General Horner knew the details of what was happening in the air campaign, or how well the campaign was progressing."[46] He then raised the question as to whether technology, without its focus on the human, had, "outpaced the ability of command and control organisations to employ and control them."[47]

The technological advancements associated with C2 afford commanders new and exciting tools in which to perform their duties. As technology in information gathering and intelligence analysis advances, the ultimate decision to attack, hold or retreat has to be made by the commander. Ultimately the final decision by the commander is very personal.[48] Harig shares these thoughts provided to him by a fellow colleague on the decision crises faced by both Generals Eisenhower and Schwarzkopf: "Both had huge staffs manned with the best minds they could assemble; both sought and used the best intelligence they had available to them, but the decision to commit forces to the offensive in the end was largely intuitive, personal and private…"[49] The decision-making process today and for the future requires knowledgeable, experienced commanders who possess a good understanding of the capabilities and limits of the technology used to assist in the making of decisions. As well, there continues to exist the requirement for excellent leadership so that staffs will have the vision and required direction to extract the appropriate information to support their commander.

THE FUTURE AND TECHNOLOGY

What will be the effect of technology on the conduct of war in the future? Whether or e
not a technology has sparked a Revolution in Military Affairs is moot. The reality is that technology is gaining a stronger foothold within all aspects of the conflict spectrum including the operational commander's decision-making process. The ability to identify the technology desired to facilitate the development of a NCW system is only a portion of the effective 1 enials thattwo oote

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In addition to addressing the more conventional wars or conflicts represented by the Falklands and the Gulf War, nations have to be prepared to deal with asymmetrical threats. To a large extent these conflicts prohibit coalition forces from concentrating energy and forces at the opponent's centre of gravity. A case in point was Slobodan Milosevic's ability to greatly reduce the effectiveness of NATO's air power by "decentralising command and control power, dispersing his forces, using human shields, and avoiding direct engagements."[52] As well Milosevic, "attacked where NATO was unwilling to respond directly – on the ground."[53] The impending war against terrorism being spearheaded by the United States after the September 11, 2001 attack on the World Trade Centre and Pentagon will pose similar asymmetrical challenges to the coalition forces. The future threat assessment by General Baril in his "A Strategy for 2020" document states:

> While Canada faces no direct conventional threat, the world is becoming increasingly complex and unpredictable. There remain direct and indirect threats to our national security for which a military response may be required, including drugs, organised crime, illegal immigration, terrorism and the uncertainty caused by the growing proliferation of missiles carrying weapons of mass destruction.[54]

As result of these views on the nature of future conflicts it is suggested, "that the type of sustained massing of forces and logistical stockpiling seen in Desert Storm are unlikely to remain the best models for future force employment."[55]

If the face of future conflict is going to change and the tools to address these new conflicts are going to be more technologically oriented, how should the CF best prepare to become a network-centric organisation? Lescher provides these three points to consider when introducing change of this magnitude into a military organisation. He reminds us that to be a successful network-centric organisation one has to focus on developing the organisation's ability to apply and be innovative with technology and not to focus on the technology itself. In order to successfully inculcate technology an organisation has to review its current organisational design and culture. This is the critical first step for any change. If the culture and organisation is not changed to reflect the introduction of new concepts the change will only last until the first crisis is encountered. Next is the organisation's boldness to experiment and gain experience with technology. This aspect of change has to be lead from the top otherwise the commitment to change by the seniors will not be evident to those charged with the implementation of the change. And finally, the rate of change has to match the pace at which one's organisation can learn and then implement. Too often innovations are introduced with the expectation that the user of this new technology will intuitively master the use of the technology therefore providing the same or better products immediately.[56]

CONCLUSIONS

This paper began with a brief discussion of the "time" factor in modern warfare. For command and control at the operational level time becomes an overarching consideration

in the formulation and design of the campaign plans for an operation. The challenges faced by the commanders in the Gulf War, in spite of and in some cases as a result of technology, were many and great. Technology has brought many new and exciting enhancements to the battlefield. While it is vital that commanders master the use and understand the limitations of NCW it is also important not to forget the value of the less tangible aspect of the art of war such as intuition and the "gut feel". The clinical sterility provided by technophiles would have us view the use of warfare technology as the wave of the future and could lead commanders to be more efficient but ultimately less effective.

The world is very dynamic and is facing asymmetrical threats not experienced in the recent past. The time to identify the system or systems one needs to be effective in the next conflict is now. With respect to bringing about change and innovative ideas, "…we always have responded better to threats than to opportunity, and leaders in any field rarely lead the way to breakthrough paths."[57] The complexity of technology and the increasing need to be compatible with allies for coalition operations requires early identification, procurement and training to ensure one's troops are capable of being as effective as possible when they face the enemy.

At the operational commander's level the lessons learned and re-learned require immediate action. Existing alliances and agreements need to be constantly reviewed and bolstered so that the time to deploy against a rapid developing threat is minimised. This immediacy is not a result of the technological RMA. Indeed, Gen George C. Marshall

observed in December 1942 that "it is utterly impossible to improvise military organisations, and it requires more than a year to build them."[58]

This paper has demonstrated that while the operational commanders in the Gulf War embraced technology there were several examples that demonstrated a lack of understanding of the capabilities and limits associated with the different equipments. The overwhelming amount of intelligence information and communication equipment and frequencies highlighted the requirement for commanders to be highly trained, experienced, critical thinking warriors.

Has technology allowed operational commanders to become more effective? The answer to this question, as demonstrated in this paper, is that technology provides operational commanders unprecedented potential to make timely, wise decisions. The key to unlocking this potential is the commanders' ability to understand the capabilities and limits of those technological tools available to them and their planners. Once operational commanders have this understanding they will be able to move forward in the use of technology from making their decisions more efficient to more effective.

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