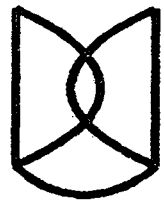
REVOLUTION IN MILITARY AFFAIRS: A CASE STUDY OF MILITARY MODERNISATION IN INDIA DURING 1990s

Dissertation submitted to the Jawaharlal Nehru University in partial fulfillment of the requirements for the award of the degree of

Master of Philosophy

Ritesh Bhardwaj



Disarmament Studies Division
Center for International Politics, Organisation and Disarmament
School of International Studies
Jawaharlal Nehru University
New Delhi

Date... 19-7-04.

CERTIFICATE

This is to certify that the dissertation entitled, "**Revolution in Military Affairs: A Case Study of Military Modernisation in India During 1990s**", submitted by me in partial fulfillment of the requirements for the award of the degree of **MASTER OF PHILOSOPLY**, has not been Previously submitted for any other degree of this or any other university and is my own work.

Ritesh 19-7-04
Ritesh Bhardwaj

We recommend that this dissertation may be placed before the examiners for evaluation.

Prof. C. S. R. Murty
(Chairperson)

Chairperson
Centre for International Politics,
Organization & Disarmament
School of International Studies
J.N.U., New Delhi

Dr. Swaran Singh
(Supervisor)

Center for International Politics, Organisation
and Disarmament Studies
School of International Studies
Jawaharlal Nehru University
New Delhi

Contents

Acknowledgements

I wish to express my deep sense of gratitude to my supervisor Dr. Swaran Singh. I was always encouraged and motivated by his constructive remarks at each and every stage of my study. He provided me much time and enough liberty to carry on this study. My heart-felt thanks to him for remarkable patience and persistence concerning not only my dissertation but also my general well being.

I am deeply indebted to my teachers at CIPOD, Prof. C.S.R Murthy, Prof. Varun Sahni, Prof. Amitabh Mattoo and Prof. Kanti Bajpai for their unrelenting support and encouragement all throughout my course of study. I would also thank Mr. Khullar and other staff of CIPOD for their sustained technical support.

I dedicate this work to my parents and my sister Era, without whom, my dissertation would have remained unrealised dream. I should also like to thank Narender, Pinki, Nitin, Sonu and Alok for their help in every possible ways. Very special thanks to Rijvan and pratima who helped at the every stage in the process of preparing this dissertation.

Ritesh 19-7-04

Date... 19-7-04... (RITESH BHARDWAJ)

Place.. New Delhi

Glossary of Terms

ALH	Advanced Light Helicopter
AWACS	Airborne Warning and Control System
ARPA	Advance Research Projects Agency
AREN	Army Radio Engineering Network
ASATS	Anti-satellite systems
ASCON	Army Static Communication Network
ASTROIDS	Army Strategic Operational Information Dissemination System
ATACMS	Army Tactical Missile System
BDA	Battle Damage Assessment
BFSRs	Battle Field Surveillance Radar
C^2	Command and Control
C^2W	Command and Control Warfare
C^3I	Command, Control, Communication, and Intelligence
C^4I	Command, Control, Communication, Computers and Intelligence
C^4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
CAO	Counter Air Operations
CCS	Cabinet Committee on Security
CDS	Chief of Defence Staff
COTS	Commercial off-the-shelf Technology
CVC	Central Vigilance Commission
CW	Cyber Warfare
DBA	Dominant Battle Awareness
DCN	Defence Communication Networks
DEWs	Direct Energy Weapons

DGMI	Director General of Military Intelligence
DIA	Defence Intelligence Agency
DII	Defence Information Infrastructure
DRDO	Defence Research and Development Organisation
EW	Electronic Warfare
EMPBs	Electro Magnetic Pulse Bombs
GPS	Global Positioning System
HW	Hacker Warfare
IBW	Intelligence Based Warfare
IGMDP	Integrated Guided Missile Development Progarmme
IRS	Indian Remote Sensing Satellite
ISR	Intelligence Surveillance and Reconnaissance
ISRO	Indian Space Research Organisation
IMINT	Imagery Intelligence
INSAT	Indian National Satellite
JDAMs	Joint Direct Attack Munitions
JIC	Joint Intelligence Committee
JSTARS	Joint Surveillance Target Attack Radar System
JV2020	Joint Vision 2020
KEW	Kinetic Energy Weapon
LCA	Light Combat Aircraft
LLOS	Long Look Optical System
MTCR	Missile Technology Control Regime
MTR	Military Technological Revolution
MMIC	Microwave Monolithic Integrated Circuits
NASA	National Aeronautics and Space Administration
NCW	Network Centric Warfare
NMD	Nuclear Missile Development Programme
NSAB	National Security Advisory Board
OCM	Ocean Colour Monitor
OPSEC	Operational Security
PGMs	Precision Guided Munitions

PSOYPS/PSYWAR	Psychological Warfare
QRS	Quick Reactions Missiles
RBA	Revolution in Business Affairs
RMA	Revolution in Military Affairs
RPV	Remotely Piloted Vehicle
RSA	Revolution in Strategic Affairs
RWA	Research and Analysis Wing
SMART	Simulation and Modeling for Acquisition, Requirement and Training
SPI	Smart Procurement Initiative
TCS	Tactical Communication System
TI	Thermal Imagers
UCAVs	Unmanned Combat Air Vehicles
UUVs	Unmanned Underwater vehicles
VLSI	Very Large Scale Integration
WGD	Weapons of Global Destruction

Chapter One: Introduction

Military modernisation of nations depends mainly on three factors: prevailing national security situation, technological capabilities of the nation and availability to provide for required defence budgets. The threat perception increases the perceived need to acquire more equipment and modernise existing arsenal, through indigenous research and development, licensed production or through purchases. The 1990s saw Indian armed forces going through various crises related to all these three aspects, viz., technology, availability of funds and real and lack of clarity about the perceived threats to its national security from outside as well as from within.

At the global level, the early 1990s were to witness far-reaching changes. These were also to bring to center stage a debate about Revolution in Military Affairs (RMA), is a new paradigm in methods, means, technologies and operational concepts of warfare but this debate has been revived by more recent experience with the application primarily of information technologies.[1] It is in this new context that the present study

[1]. See for examples, Kapil Kak, "Revolution in Military Affairs–An Appraisal", *Strategic Analysis* (New Delhi), April 2000, Vol. XXIV no. 1, pp. 5-6; Akshay Joshi, "A Holistic View of the Revolution in Military Affairs", *Strategic Analysis* (New Delhi), February 1999, Vol. XXII no. 11, pp. 1743; Ajay Singh, "The Revolution in Military Affairs – 4-Dimensional Warfare", *Strategic Analysis* (New Delhi), May 1998. Vol. XXII no.2, pp. 160-161.

makes an attempt to locate India in the global debate on RMA in the 1990s, a decade in which RMA was introduced and put to test. For India, this was a period of intense strife in all three counts of threats to national security, technological capability and budgets.

Military Modernisation and RMA

In the developing nations RMA has been especially integral to their military modernisation process. For developing nations modernisation generally implies three things: domestic cohesion around rational as against primordial consciousness, autonomy of the individual and his participation in the socio-economic process and the growth of the technological capability.[2] In the last decade of the 20th century, new scientific developments based on Information Technology (IT) had begun to influence military structures the world over. It must be remembered that IT-oriented RMA changed not just the strictly technological aspects of warfare, but applied to nearly every aspect of defence: military doctrines, operational concepts, force levels, weapons and modes of warfare. American National Standard for Telecommunications defines Information Technology in its *Telecom Glossary 2000* as:

> "The brand of technology devoted to (a) study and application of data and processing thereof, the automatic acquisition, storage, manipulation (including transformation), management, movement, control, display, switching,

---

[2]. Rakesh Gupta, India's National Security: Some Aspects, in M Rasgotra (ed.) *India's Foreign Policy in the 1990's*, Patriot Publisher (New Delhi), 1991, p. 83.

interchange, transmission of reception of data and (b) development and use of hardware, software, firmware and procedures associated with this processing". [3]

However, till date, there has not been any standard definition of Revolution in Military Affairs (RMA). Many military journals have discussed the RMA and its impact in the future wars. This is generally believed to be characterised by speed, intelligence and precision. No doubt, the older form of warfare will co-exist with the newer from driven by RMA. The newer form will differ from its antecedents. Soldiers with higher IQs will conduct future forms of wars, sophistication in weapon system will invite better quality of decision cycle. That is why Institute of National Strategic Studies concludes: "A final feature of definition of RMA is a 'culminating event', and a battle that employs new systems, operational concepts and organisations and that clearly demonstrates a dramatic change in the conduct of warfare."[4] Michael Vickers has identified a number of cases, which satisfy the definition of RMA.

- "Those nations that became aware of the importance of technological change and adapted operationally and organisationally accrued major advantages. Others then had to try to catch up rapidly. An example is the German Blitzkrieg and the Allied attempt to master this new approach to armoured warfare.
- "New, very different measures of merit, of effectiveness, became relevant, the old ones are more quickly discarded by the winners, who learn to adopt the new ones.
- "Some material organisations and operational concepts decrease in importance (sunset systems) in these periods while other increase (sunrise systems). Winners are sensitive to these changes and act on them.

---

[3]. *Telecom Glossary 2000,* American National Standard for Telecommunications, Washington at http:||www. Atis.org/tg2k

[4]. Martin Van Creveld, *On Future War*, Brasseys (UK), 1991, p. 2.

- "Losers planned for the future by using their current organisations and practices as a point of departure. They were content to graft technological change into existing structures and operations and to improve them at the margins."[5]

Another best-known definition of RMA is the one provided by Dr. Andrew Marshall, Director of the Office of Net Assessment, US Department of Defence. He describes it as a major change in the nature of warfare brought about by the innovative application of new technologies which, combined with dramatic changes in military doctrine and aerations and organizational concepts, fundamentally alter the character and conduct of military operations.[6]

Andrew Marshall's definition obviously links technology to the doctrine, operational and organisational concepts. If it was a mere introduction of a new weapon, like the AK-47, such an overhauling of military affairs would not be warranted. What leads to a re-look at operational and organizational concepts is a massive change in technology, which is partly a result of social changes, and partly a cause of such changes. In other words, while Information Technology represents its key motivation, RMA is not just the use of computers or electronics in the theatre of warfare, but something that affects militaries and security debates on a deeper level. It is different from military revolutions, which means the major changes in the

---

[5].Michael Vickers, *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe* (Boulder: Westview Press). 1995, p. 13.

[6].A W. Marshall, Director of Net Assessment, office of the Secretary of Defence, Washington, D.C: memorandum for record, subject: *Some Thoughts on Military Revolutions*–Second Version, 23 August 1993, p. 44.

way states waged war: like the changeover from bows and arrows to use of guns and cannons, and then of air power and so on. [7]

Military science evolves all the time. During the career of any officer, lasting 35 to 40 years, the service that he entered is unlikely to be the service he leaves behind. But the change that he is witness to is, as stated earlier, an evolutionary process. Some generations are lucky or unlucky to witness a revolution. This is nothing but evolution compressed in time. The factor of time is critical.[8] Over a number of years, all services evolve, but that is not enough. Occasionally, when a military revolution is taking place, a service may still be evolving and be left behind on the wrong side of the revolution. In this sense the RMA that is currently taking place may be looked at in two parts. The first part is the *Result* of the RMA and the second the *Causes*. The result of the current RMA is that it is now possible to speed up the enemy's command and control collapses, and a rout takes place.[9]

---

[7]. Thierry Gongora, "The Revolution in Military Affairs: what should the CF do about it?" *National Network News,* The Defence Associations National Network (Vancouver), Volume 5 no. 2, Summer 1998, p. 34.

[8]. David Tucker, "The RMA and the Interagency, Knowledge and Speed vs. Ignorance and sloth in Parameters", *US Army War College Quarterly* (Washington D C), Autumn 2000, pp. 66-67.

[9]. Rear Admiral Raja Menon, *Maritime strategy & continental wars*, Frank Cass (London), 1998, p. 33.

Causes and Results of RMA

Revolution heralds change. RMA is a result of changes in the way military affairs are organised, and it creates changes in the way conflicts will be handled. Let us briefly re-count what has changed in terms of military to bring about a change in the way nations look at warfare?

- Socio-economic changes of the last decade of 20th century: best described by the visionary Alvein Toffler and Heidi Toffler as 'Information Revolution' has changed the way violence is conceived and applied.

- Politically, the world has become a global village characterised by integration and their intervention in conflicts of other nations (Gulf War, 1990) or even in the conflicts within nations (Kosovo, 1999) often at the peril of the concepts of state sovereignty and territorial integrity.

- Militarily, the proliferation of Weapons of Mass Destruction (WMD) has brought about fear of Mutually Assured Destruction (MAD), which in turn has shifted the focus to low intensity conflicts and clinically precise strikes.

- The expansion of global media and communication facilities meant events are transmitted across continents in real time (meaning as they happen), evoking immediate reactions from all part of the

world on any type of conflict. These bringing new strength to global opinion and institutions.

- The transmission of images of war across the world meant that any country violating international norms of behaviour will not be immediately condemned, but also stifled both economically and militarily (Iraq's invasion of Kuwait in 1990 is a case in point).

- Moreover, the concept of war as one state invading the territory of other has almost died down, as the states are faced with new threats, often from non-state actors, like separatists, insurgents, secessionists, organized criminals and terrorists. These are but some major aspects. But each has to be discussed in detail.[10]

Societal changes: From Agrarian Age to Information Age

The present RMA, broadly defined, results from the passage of advanced societies from an industrial base to an information base. Alvin and Heidi Toffler vision of the history of technological development and warfare is encapsulated in their model comprising three waves: The Agricultural revolution (first wave), Industrial revolution (second Wave) and Electronic revolution (third wave). The Tofflers argue that the agricultural revolution initiated the first great phase of change in human civilisation, enabling communities to produce economic products which were at the root of many

wars (the link between war and soil being close in ancient times), the industrial revolution then precipitated a second wave of technological and industrial transformation, leading first, to mass production standardisation in both the civil and military sectors, and second to the introduction of weapons of 'mass' destruction simultaneously affecting the nature of training, organisation and doctrine, and finally, the US, Europe and Japan are now poised at the brink of a third wave of change: the new post-industrial, Information-based technology age.[11]

Tofflers call the 'Third Wave' as one that refers to the Electronic Revolution, alternatively known as the Information Revolution. Computing and calculating machines were invented in the industrial age itself. [12] While Industrial Revolution had a life span of 250-300 years, electronic revolution is just over 50 years old now. But in terms of wealth, what the industrial revolution did to amplify power of human muscles, the electronic revolution did to the same amplify the power and capacity of human neurons. This wave witnessed and explosion of information. While Industrial Revolution gave mankind the telegraph, rail, road, ship and aeroplane. Electronic Revolution led to inventions of radio and television, and later, computers.

---

[10] . Ibid, pp. 34 –35.

[11] . A and H. Toffler, *War and Anti-War*, Warner (New York). December 1994, pp. 12-13.

Information Age and Changing concept of Power:

Discussions in the RAND Corporation in the early years of Cold War were premised on the threat of a possible nuclear war with USSR. A major concern was how a post-nuclear America would preserve its command and control network, linked from city to city, state-to-state, and base-to-base. In case of an atomic attack, any central authority would be an obvious and immediate target for an enemy missile. The center of the network would be the very first place to go.

Against this possibility, RAND staffer Paul Baran introduced a network structure, which was made public in 1964. Baran's idea of network would have one central authority and will be designed to operate while in tatters. All the nodes in the network would be equal in status to all other nodes, each node with its own authority to originate, and pass, receive messages. Shortly afterwards, the pentagon's Advanced Research Projects Agency (ARPA) decided to fund a larger, more ambitious project in the USA. This pioneer of Internet revolution, ARPANET formally expired in 1989. But Internet was soon 'demilitarised' and become one of the greatest civilian technologies. There is no system that reflects the democratisation of information the way the Internet does. The use of computers for international computation further enhanced and expanded how humans connect, communicate and create communities. It has realigned social and

---

[12] . n. 9, p-35.

economic dynamics. All commercial organizations are forced to enter this truly global market place. [13]

As regards military affairs, and accurate timely information has always been eagerly sought by armed forces and defence planners throughout history. Two thousand years ago, salience of information management was extensively articulated by the Indian thinker and military strategist, Kautilya. Gengiz khan, the Mongol conquer was the master of employing horse cavalry in outflanking forays against enemy deposition for vital information gathering prior to the main offensive. Today, in the Information Age, concepts of distance and position lose their relevance since immaterial goods transmission can be carried out at lower costs and regardless of the distance. State power depends on the capability to innovate, rather than just managing and controlling available resources. Due to the possibility of long-distance communication, traditional institutions lose knowledge monopoly and control over it's spreading.

Information Revolution transforms organising models in society and production, from vertically hierarchical structures to horizental structures, all directly reachable to all potential political and economical protagonists. Traditional institutions, keeping a vertical and hierchical structure thus find

[13] . R.J. Garigue, Information Warfare: Developing a Conceptual Framework, Decision *Analysis Laboratory* (Washington D C), Carleton University, Draft Version 2.1, 2000, p. 4.

it hard to resist these new organisations. Hence the difficulties caused to states by global terrorism, trans-national crime, and relevance of NGOs and lobby groups. Therefore, in information societies, governments must face directly a public opinion that is constantly informed about events as they occur. Political actors must chase events, being always bound by preservation of consensus, and this produces a practical impossibility of long-term planning and of preventive action.[14]

Information Revolution could, however, be useful for governments as a political instrument and force multiplier, putting together the traditional hard power (often characterized by military muscle) with what is known as 'soft power.' Soft power means the capacity to obtain prefixed political goals through consensus, through the use of information aimed at persuading the other party to act in accordance with one's interests. In the case of traditional hard power, focus is on information dominance to discover the counterpart actions and strike it. In the case of soft power, the final goal is to obtain the ideological dominance that is the capability of persuading the counterpart due to superiority of economical, cultural and organisational model. Obviously, the soft power can also be used in a defensive way to protect the national model from an aggressive foreign model. [15]

---

[14] . Carlo Finizio, "Challenges of the Information Revolution", Paper Presented at second Asian security Conference, Towards a New Asia at Institute of Defence Studies and Analysis (New Delhi), Jan 2001, p. 2.

[15] . n. 9, p. 38.

In the information Age, it was soon realised that Information Revolution empowers non-state actors as much as it does States.[16] Like the computers, which often functions in interconnected network systems without hierarchies, the world has witnessed terrorists and organised criminal gangs effectively developing such networks in the last decade. Information empowers the non-state actors, a key security, with non-hierarchical command structure, while state actors continue to follow hierarchical command systems. In this context, the method for waging war should be to enter the enemy's decision making cycle and gain insights in his strategy, powered by new information technologies, it involves defensive methods of denying enemy access to our systems, and offensive methods of getting into the enemy systems to disrupt their smooth flow of information.

While information can be described as "what is happening", knowledge is "what It means" to a single observer with specific interests and creation of such context forms the focal point of knowledge management, as it looks at the relevance or pertinence of one set of information with regard to another. In a computing environment, knowledge management world involve the creation, transformation, storage, usage and replacement of highly complex

---

[16] . Frank J. Cilluffo, "The Role of Intelligence in Identifying, Preventing and Responding to Transnational Terrorism", Remarks to the American Bar Association Standing Committee on Law & National Security December 10, 1996. Transnational Threats Resource Center, Global Organized Crime Project, Central for Strategic and International Studies (Washington DC) at www.csis.org/goc/a0961210.html

models and computation structures, which create meaning in a formalised way. [17]

Computing Schools of Thought in RMA

According to Andre Krepinevich jr. at a conceptual level, there are perhaps four main school of RMA thought.[18] The first three are progressively more bullish in their RMA enthusiasm, the last school is of a different type.

-The system of system school

-The dominant battelspace knowledge school

-The global reach, global power school

-Vulnerability school

SYSTEM OF SYSTEM: Virtually all contemporary RMA visions emphasise the concept of a system of systems: that future warfare will be dominated less by individual weapons platforms and munitions than by real-time data processing and networking that tie U.S forces together synergistically. Proponents point to the fact that computers have been getting much faster for years. Supercomputer computational power has been increasing by a factor of ten every five years.[19]

---

[17] . n. 6, p. 45.

[18] . Andrew Krepinevich Jr., " Cavalry to computer: The patterns of Military Revolution," *National Interest*, no. 37(fall), 1997, pp. 33-34.

[19] . Kenneth Flamen, "Controlling the Uncontrollable", *Brooking Review*, vol. 14, Winter 1996, pp. 22-25.

Trends in computing power, speed, cost, and size have made it possible to put computers on ballistic missiles, fighter's jets, and phased-array radars in the last few decades. Further advancements now make it possible to put computing capability on all significant platforms and to network the systems together. This will allow such systems to gather information from many sources, process it in real time, and rapidly exchange data in the battlefield. Radical progress is under way in C^4– or command, control, communication, and computers – technologies, and the U.S military should be able to derive great benefits form that progress. The system of systems phrase was popularised by Admiral William Owens, who served as vice chairman of the Joint Chiefs of Staff in the mid-1990s.[20]

DOMINANT BATLESPACE KNOWLEDGE: Many of those who accept the system of systems concept expect even more from future military technology. Convinced that radical improvements are under way not only in computers but also in sensors that gather information, they have invoked the phrase Dominant Battlespace Knowledge (DBK) to describe a future combat environment in which the United State would be able to promptly find and continuously track virtually all important enemy assets within a combat zone often specified as being 200 nautical miles square. This is roughly the size of key battlefield areas in a place such as Kuwait or the Korean peninsula.

---

[20] . Jospeh S. Nye, "American Information Edge", *Foreign Affairs* (New York), Vol. 75 no 5, March-April 1996, pp. 23-24.

As its name suggests, the DBK school is much more bullish and ambitious than the System of Systems school. It not only presupposes the rapid processing and exchange of information on the battlefield, but also the availability of much better information to process and exchange. In other words, it expects breakthroughs not only in C^4 technology, organisations, and capabilities, but also huge strides in intelligence, surveillance, and reconnaissance (ISR), making for a complete C^4-ISR revolution in military affairs. As one prominent proponent, former chief of staff of the air force Ronald Fogleman, put it before congress in 1997: "In the first quarter of the 21st century you will be able to find, fix or track, and target – in near real-time – anything of consequence that moves upon or is located on the face of the Earth."[21]

Clearly those who subscribe to the more limited system of systems concept understand that sensors will continue to improve. For example, the miniaturisation of electronics, on-board all this will amount to a true revolution in military affairs by 'eliminating the reliance redesigning the ground forces around the enhance combat cell (light, agile units with information-processing capabilities,' GPS receivers, and secure high-data-rate radios now make possible devices like unmanned aerial vehicles

---

[21] . Goldmen, O and Eliason, C. *The Diffusion of Military Technology and Ideas*, Stanford University Press (California), 2003, p. 57.

(UAVs). In addition, improvements or innovations in sensors will probably take place in areas such as multi-spectral imaging and foliage-penetrating radar, which will be important in certain specific contexts. Proponents of the system of systems concept do not, however, anticipate that sensors will improve so drastically as to make the battlefield transparent.

GLOBAL REACH, GLOBAL POWER: Certain schools of thought pace a heavy premium on new types of weaponry to deliver ordinance extremely fast and new ways. Proponents of this type of vision contemplate being able to base forces in the United States but deploy them rapidly and decisively overseas within hours or at most a few days; they also see the United States being able to avoid dependence on large fixed bases in combat theaters.

The U.S Air Force first coined the phrase "global reach, global power", and used it to argue for more resources for certain types of air force programs. Given its dominant role in winning that Persian Gulf War – not to mention Operation Allied Force against Serbia in 1999 this is not surprising. Some additional attributes of air force-oriented force postures are that they promise wars with few U.S. causalities and a rapid U.S. military response to crises or conflict virtually anywhere on earth.[22]

Although these air force visions vary, they generally emphasise the firepower and rapid-response capabilities of systems such as stealthier air-

[22] . Ibid, p. 59.

to-air fighters, B-2 bombers, advance reconnaissance capabilities such as UAVs, and "brilliant" munitions like the sensor-fused weapon (SFW) with autonomous terminal homing capabilities that do not require human operators in their final approach to a target.[23] The concept of global reach and global power goes well beyond the air force. However, For example, some envision that ground combat units will be organised in radically different ways, permitting them to deploy very rapidly with only modest amounts of equipment and supplies. They might function in very small mobile teams that conduct tactical reconnaissance and call in precise strikes from distant ships or aircraft as they locate enemy assets difficult to identify from air or space. According to 1996 Defence Science Board task force:

> "There is a good chance that we can achieve dramatic increase in the effectiveness of rapidly deployable forces if chance 10 to 20 personnel each proves to be robust in many environments. There is some of our force on the logistics head as Blitzkrieg freed the offence after World War I from its them decades old reliance on the railhead." [24]

VULNERABILITY: The final major school of RMA thinking is motivated by worries as much as optimism or "technophilia." It highlights the growing threat posed by enemy cruise, antiship, ad ballistic missiles; advanced satellite technologies of communication and targeting, sea mines and advanced diesel submarines, the physical and electronic vulnerabilities

---

[23] . Denial Goure and Christopher M.Szara, (eds) *Air and Space Power in the new Millennium*, Center for Strategic and International studies (Washington DC), 1997, pp. 10-12.

[24] . M. Thomas Davis, *Managing Defense after the Cold War*, Center for Strategic and Budgetary Assessments (Washington D C), June 1997, p. 4.

of information and communications systems on which the U.S armed forces increasingly depend, the proliferation of chemical and biological weapons, and the enduring challenges of urban and infantry battle. These technologies could make it much harder for the United States to teach foreign ports safely, keep those ports as well as airfields and other infrastructure safe from enemy attack, and protect troops on the battlefield.[25] The vulnerability school of thought frequently invoke the term asymmetric warfare in arguing that future adversaries will choose to attack the United States differently than the United States would choose to fight them. That conclusion applies both to the battlefield, and to the American homeland, since foes might attempt terrorist acts against US civilian and economic centers in an attempt to deter or defeat US military action against them.[26]

Changing Global Security Scenario

The changing face of modern warfare involves numerous low intensity conflicts, where states confront non-state actors supported by other states or acting alone, the pressures of the media and the need to show to the public (often through media) that something is done; the asymmetric nature of threats, where even nuclear powers fail to deal with suicide bombers, and

---

[25] . Andrew F. Krepinevich, *The Conflict Environment of 2016: A Scenario-Based Approach*, Center for Strategic and Budgetary Assessments (Washington D C), 1996, p. 37.

[26] . Gary Hart, *New World Coming: American Security in the 21st Century*, Alexenderia Va: U.S Commission on National Security 1st Century, September 1999, p. 53.

the general global opinion against war and abhorrence of huge war casualties.[27] The present RMA is not just a revamping or overhaul of militaries but a response to these changes in nature of conflicts.

In asymmetric threats, state militaries find themselves fighting individuals and organisations armed with rather unsophisticated, even primitive (as in the slingshots of Palestinian intifada versus the mighty Israeli army) weapons. The pressure of global opinion–brought about by its real-time dissemination through cable and satellite television networks will be on the military to avoid usage of heavy artillery–for fear of international condemnation.

It should be noted that the same microchips churned out by private industry could be used both in civilian applications and precision-guided munitions. This helps rogue states as well as non-state actors who thus far could not have afforded large scale, costly military equipment to now acquire these technologies off-the-shelf, relatively cheaper. Information or rather the asymmetry of information has emerged as the key factors in winning wars of the future. The problem is not the availability of information, but the narrowing down in the asymmetry of information, as it is available for everyone literally at the click of a computer mouse. From the vast sea of knowledge, military planners have the task of sifting information that can

---

[27] . Dan Goure, "Coping with Chaos: The changing face of Modern warfare", *Jane's Defence weekly* (New York), Vol.35 no.3, January 17, 2001, p. 23.

be put to available. The threat of nuclear, biological and chemical weapons of mass destruction has also pre-empted an all-out, long drawn war of attrition, as it could lead to annihilation.

Perhaps the greatest change in security scenario that has led to an RMA is not the technological revolution in platforms, munitions, guidance, surveillance and command and control, but in the nature of warfare itself.[28] Most countries are realising that threat of foreign invasion has virtually vanished. Invading a neighbour is contrary to current global norms and is illegitimate. Iraq found it very hard way. Globalisation may have largely erased borders for investments, trade, information and other exchanges, but it reinforced them against military aggression.

International crime and terrorism, piracy on the high seas, drug trade and smuggling of human beings threatens the jurisdiction of all governments over their people and territory. In such scenarios, combating them becomes a military function in co-ordination. These factors will increase the importance of navies, marines and airforces, faster and lighter vehicles and military units and civilian authorities.

---

[28] . Nicholas Berry, "The Revolution in Military Affairs (RMA) is not only about high-tech weapons", *Asia forum*, Center for Defence Information: Massachusetts Avenue (Washington D.C). August 2000, available at www.cdi/asoa/fap81600.html

Changing concept/methodologies of warfare:

With the fall in defence spending after the end of Cold War, the armies were required to fulfill task with decreased resources and manpower, which increased the need for force multipliers often provided by innovations in information technology, primarily meant for civilian applications. This is an interesting aspect, because earlier, it was often. The military technologies that were later put to civilian use. Now the cycle is being reversed.[29]

Since IT-oriented RMA is not just about technology, military thinkers have started coining new modes of warfare that require new operational concepts and application of relatively upgraded technology. Much of it continues to be in theoretical stage, and has often overlapping descriptions and definitions.

According to the Discipline Dictionary of Information Warfare and Strategy, National Defence University of Washington, "action taken to preserve the integrity of one's own information system from exploitation, corruption, or destruction while at the same time exploiting, corrupting, or destroying an adversary's information systems and in the process achieving and information advantage in the application of force". It is also the actions

[29] . Kapil Kak, "Revolution in Military Affairs–An Appraisal", *Strategic Analysis* (New Delhi) April 2000, Vol. XXIV no. 1, p.

taken to achieve information superiority in support of national military strategy by affecting adversary information and information systems while leveraging and defending our information systems. Command and control warfare is a subset of information warfare.[30] Another definition given by Dr. Ivan Goldberg states:

> "The offensive and defensive use of information and information systems to deny, exploit, corrupt, or destroy, an adversary's information, information-based processes, information systems, and computer-based networks while protecting one's own. Such actions are designed to achieve advantages over military or business adversaries".[31]

Network-Centric Warfare (NCW) and System-of-systems approach are two other concepts being discussed by military thinkers.

The possibilities offered by global networks like the Internet satellite communication facilities, video-conferencing, global-roaming cell-phones etc have helped network-centric warfare. Briefly, it means an approach to warfare that benefits from linking or networking of the war-fighting enterprise. NCW leads state militaries to change their hierarchical organisation and exclusive functioning of the three services-army, navy and airforce and evolve more loosely held command-action set-ups which would not look towards a single commander as also jointness in doctrine and action. The NCW is characterised by the ability of geographically dispersed forces, consisting of entities or cells to create high level of shared battle-space awareness. This knowledge can be exploited through self-

---

[30] . Definition for the, *Discipline Dictionary of Information Warfare and Strategy*, School of Information Warfare and Strategy, National Defence University (Washington D C), p. 37.

[31] . Ibid.

synchronisation and other network-centric operations to achieve commander's intent.

RMA at Present:

Often, people consider RMA as happening only when new technologies occur and are implemented. This is not actually the fact. For example, Tipu Sultan was the first Indian military leader to use rockets in warfare. But this did not lead to a military revolution at least in India. Gunpowder was discovered in China.[32] The present RMA stems from the concept of Military Technological Revolution (MTR) developed in 1980s by Soviet Marshal General Nikolai V Ogarkov, an officer living in a society not noted for its technical innovations. He was, a leader in an armed force in which the study of military theory and operational doctrine and their relationships are paramount. The idea of the RMA as Ogarkov saw it was essentially doctrinal which stated that technological change would not bring about a revolution in military doctrine characterised mainly by the capabilities of advanced states to fight wars simultaneously and almost limitlessly across the breadth and depth of the battlefield. MTR aimed at long-range precision strike capabilities by creating combined intelligence, surveillance and reconnaissance (ISR) system, with the ultimate aim of a war without soldiers. Soon America took note of MTR and pentagon began to develop the Revolution in Military Affairs in the mid-80s. It involved doctrinal and

---

[32] . O' Honlon Michael, *Technological change and the future of warfare*, Brooking institution Press (Washington DC), 2000, p. 24.

organisational changes as well as use of new weapons. The US and its allies in the Gulf War tried out the concept of maximum impact with minimum casualties for the first time.

High tech, high-cost weapons were used, which were less in number and more effective. But the RMA in proper did not occur in the Russian State. RMA has three major components: [33]

(a) Doctrine

(b) Technology

(c) Tactics & Training

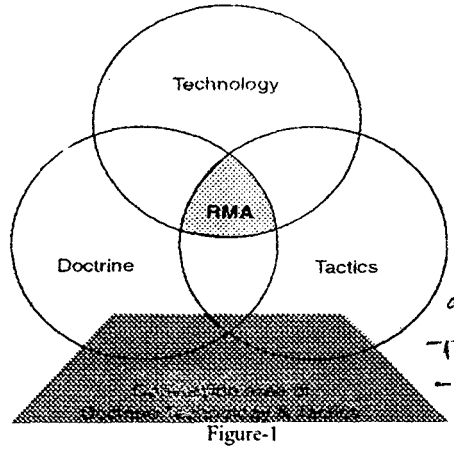


Figure-1

Among these, *Doctrine* must be considered as the most important component. Simply stated, Doctrine means our beliefs about how we use the armed forces. Purely defensively, purely offensively, or individually, which will inevitably result in a lack of coordination. Whether we use military jointly along with other instruments of national power i.e. along with diplomacy, financial muscle and most important with the willing support of our citizens, these doctrinal factors therefore needs to be kept in mind when we examine the Indian experience in RMA.

---

[33] . Ibid, p. 25.

The next component of RMA is *Technology*. The complexity of modern day technology has increased manifold. So acquiring technology is one thing, understanding it and employing it most optimally is another. It requires years of trainings under realistic conditions.

Tactics derive form a mixture of doctrine, Strategy and technology. Training refines and perfects our tactics. The tactics that we want to use during actual war need to be developed under realistic war conditions or conditions as close to actual war as possible. Naturally there is a great difference between war conditions and conditions for peacetime training. As we simulate war conditions our chances of accidents and loss of lives and military equipment increase. So then, how does one train to derive tactics that will work in the ensuing war. This is one of the most difficult problems facing military commanders everywhere. It must, however, be acknowledged that technological advances are reducing the gap between simulation and reality. RMA is a new term and a western follow-on to MTR origination in the erstwhile USSR in the early 80's. RMAs have continued to occur throughout the 187 generations of mankind though in varying degrees and intensity. As other nations learnt and incorporated the new RMA occurring in the lead country, the RMA were again replaced by war of attrition, till another such RMA comes about to break the deadlock.

Creation of the modern and effective nation state based on organised military power in the 17 century, the French revolution and the industrial revolution (beginning at the same time during the period 1789-1815) and First World War are cited as epochal events that brought in their wake such systemic changes in the political, social and cultural arenas as to be largely uncontrollable, unpredictable and above all, unforseeable. Throughout history nations have always pursed innovation in increase relative military effectiveness. It is the acceleration of evolutionary technological change combined with associated operational and organisational transformation that altered the character of war over the last two hundred years. Some of these developments that progressively shaped the eventual technological metamorphosis are:

- Railways, telegraph, steam - powered naval ironclad and rifle.
- Change over from wooden sailing ships to steam powered armoured hulls.
- Machine gun, aircraft, submarine, main battle tank and armoured fighting vehicles.
- Internal combustion engines, improved aircraft, radio and radar.
- Nuclear weapons, ballistic missiles.
- Information technology and micro-chip advances, laser, satellite applications.

The following RMAs have been listed by James Adams in his book *The Next World War – Computers are the Weapons and the Frontline is Every Where* (1998) they can be summed up as follows.

a) 1340 AD = The Bow makes army cheaper and therefore bigger.
b) 1420 = Artillery replace old concepts of siege warfare.
c) 1600 = Ships carry artillery, marking the state of modern naval thinking.
d) 1600 = Musketry adds standoff lethality to hand-to-hand combat.
e) 1600 = Efficient construction methods make fortresses defensible again.
f) 1800 =Birth of modern army with rationalised equipment and staff system.
g) 1850 =Naval Revolutions includes metal hulls, steam turbine engines long -range artillery submarine and the torpedo.
h) 1860 =Railroad and telegraph enable mobility and communications. Rifling and the machine bring new levels of accuracy and destructions.
i) 1915-16 = Carrier aviation.
j) 1917 = Tanks.
k) 1920 = Strategic bombing, amphibious assaults.
l) 1945 = Nuclear weapons.
m) 1990 = Microchip.

RMA can be considered to occur when a combination of the three components of the RMA i.e. the Doctrine, Technology and Tactics, in varying degrees permit one side to achieve a quick and decisive victory over the other. Napoleon's RMA was a mix of the doctrine of massed troops in maneuver and associated training and logistics. The German Blitzkrieg was a combination of all the three, whereas World War I saw the emergence of many new technologies like the Maxim Machine Gun, the Submarine the Aircraft, and the Tank, it did not produce an RMA then and there.

However, when Americans today talk of RMA, there is one more element implicit in it. That is a quick victory and that too with the least loss of men

and material. It is interesting to note that casualties during the US civil war were close to 1 million. In one year's participation during World War I, the US casualties were well below 100,000. During the four years participation in World War II their casualties remained below 100,000. In Korea and Vietnam these were closer to 50,000. Since then there has been a dramatic reduction. Similarly, when the Germans astounded the world by their Blitzkrieg, the Blitzkrieg itself was not without casualties. In the polish campaign the Germans lost 210 tanks (10 percent of their strength), 564 aero planes, (about 25 percent of the committed force), 11,000 killed and 30,000 /34000 wounded and missing. In the French campaign the German losses were 753 tanks (30 percent of tanks) and 1,900 aeroplanes (roughly 50 percent). The Israelis achieved one of the quickest and most devastating air and ground victories in 1967. However, for their victory they did pay a heavy price. Out of 800 tanks, the Israelis nearly lost 211 tanks as destroyed and many more damaged, but subsequently recovered and repaired. That is about 25-50 percent tanks were destroyed. The Israelis lost 50 aeroplanes, that is, about 25 percent of their Air Force, 778 killed and 2,586 wounded.[34]

However, since Gulf War of 1991, a new dimension in RMA has occurred. That is the dimension of complete victory with least losses to the victor. The MNF casualties were 4 tanks and 8 AFVs, 73 aerolanes, 147 killed, 75

[34] . Jackson AV William, *History of India*, Asia Education Services (New Delhi), 1987, p. 2.

missing and 513 wounded. In Bosnia in 1995, a 22-day air campaign achieved the political objectives .The losses to peace enforce were only one F-16. IN Kosovo in 1999, the 78-day air campaign again achieved the political objective. Yet the losses were only two fighters and nil aircrew.[35]

The ongoing war against terrorism in Afghanistan since 7th October 2001 is too recent to warrant repetition. The above examples underscore the new dimension of the RMA. But we must be careful lest the chip and the microprocessor overshadow the doctrinal changes and changes in tactics, which have an equally important contribution in the American RMA. Thus the basic concept of RMA was successfully experimented by the US in 1991. By further analysis of the Gulf War, new concept and doctrine were developed in the latter part of the 1990s. US army formally adopted RMA as the Air-Land Battle (meaning joint operations of army and airforce) in the official doctrine field Manual (FM) 100-5 and called it Joint Force Doctrine. The principles of FM 100-5 were envisioned in Joint Vision 2010, published in 1996 July by the Chairman of the Joint Chiefs of Staff, which was, modified in Joint Vision 2020, published in 2000. There were five main concepts introduced in JV 2010: dominant maneuver, precision engagement, full dimensional protection, focused logistics and information superiority. The declared mission was achieving dominant battlefield knowledge over the enemy, to clear what the German general Carl Von Clausewitz called in *On War* the fog of war and what Duke of Wellington

---

[35] . Ibid.

described as 'Other Side of the Hill'.[36] Information technology, aerospace technology and warfare materials as key factors. USA tried out a combination of these in the research and development of Strategic Defence Initiative, Theatre Missile Defence and National Missile Defence system.

Response to RMA by the rest of the world

The possible responses to overarching changes in military strategy by one nation or a group of nations could be in different ways: deploy a different set of weapons/technologies or develop new ways of fighting in order to offset of bypass the new capabilities of the breakthrough state.[37] Already, armies are decreasing in size as a result of the current RMA, with many emphasising a move away from conscription to a full-fledged professional and highly technical service. The nations of the West, namely the United States and its Western European allies within the current NATO, remain the most powerful military powers in the world. America's substantial security margin is reinforced by the strength of its allies. These states plus other long-time American allies account for more than 70 percent of world military spending. Thus, a general diffusion of military power has slowed dramatically and has come substantially under the control of the United States and its allies, thus widening its military gap with most of the Asian

---

[36] . Joint Force Doctrine in *"Joint Vision 2010: America's Military Shaping the future"*, Joint Chiefs of Staff Committee (Washington DC), January 1996, p.8, at www.dtic.mil/jv2010/jv2010.pdf

and African nations. Thus, for a long time to come, U.S. armed forces are deemed to be the only ones capable of fully exploiting the technologies and making the necessary organisational and doctrinal changes to benefit from the current RMA. European countries of the NATO alliance do not have the budgetary capability for research and development incentive to fully emulate the U.S. RMA. This gap can result in unease on both sides of the Atlantic and serious operational difficulties between U.S. forces and other NATO forces that are participating in exercises, operations other than war or combat operations.

Hasim quotes a study by the German Army, the Bundeswehr, which, while highlighting importance of information-driven technologies in the current RMA, also warned about the growing gap in this area between the United States and its allies.[38] People's Liberation Army is advocating a string of measures to develop RMA capabilities. Policy pronouncements of the Chinese military in the last two decades-military modernisation as part of Deng Xiaoping's four modernisation of 1978, and the national defence strategy outlined by the Central Military Commission in 1985 have laid the foundation for an RMA in China. PLA was asked to focus on local, conventional wars and any sudden crises around the Chinese periphery. This re-orientation was based on the view that Mao Zealong's idea of

---

[37] . Ahmed S. Hasim, "The Revolution in Military Affairs outside the west", *Journal of International Affairs*, Columbia University Press (New York). Vol. 51 no 2, Winter 1998, p. 33.

[38] . Ibid.

people's war was outdated in an environment that called for rapid responses with high lethality.[39]

PLA continues to give strong concentration on force ratios as the index of relative military power, and emphasis on building massive weapons platforms geared to establish dominance through sheer volume of fire. But there is strong realisation that high-tech warfare has developed from an emphasis on guided missile to one on information and that firepower superiority relies on information superiority. Chinese are hard at work in developing these capabilities.[40]

The movement it makes towards adopting RMA is significant. There is attention on developing combined arms, rapid deployment units (kuaisu fanying budui), and force mobility, long-range force projection and developing airlift and sea lift capabilities. Both the PLA Navy (PLAN) and Air Force (PLAAF) are undergoing modernisation programmes with this aim. But to a large extent, China will continue to acquire foreign technology to achieve modernisation objectives, but China is yet to manage co-ordination between military and civilian R&D efforts. Chinese expenditure on current RMA-type weapon systems is largely concentrating

---

[39] . Bappaditya Mukherjee, "China and the RMA", in Kanti Bajpai and Amitabh Mattoo (eds) *The Peacock and the Dragon: India-China Relations in the 21st Century*, Har Anand (New Delhi), 2000, p. 109.

[40] . M V Rappai, "China's Military Modernisation: Some Perspective", *Strategic Analysis* (New Delhi) January 1998, Vol. XXI no, p. 1419.

on electronic components. One or two of PLA's group armies possess advanced automation systems that integrated field command, providing them with operations simulation and computer plotting tools. This also allows electronic transmission of documents from the group armies level to division and regimental commands. China is readying to integrate information warfare into its geopolitical strategies and concept of People's War. [41]

Modern Japan constitutes an intriguing case study. It was the first non-Western nation to successfully emulate Western ways of war. However, following its devastating defeat in the Second World War, Japan developed a strong anti-militarist, indeed pacifist, orientation that abjures war and holds the military profession in low esteem. Modern Japan is an advanced technological society with considerable expertise in many of the information technologies that are relevant to the current revolution in military affairs. Moreover, Japan has a small and insignificant, albeit high quality, defense industrial base and R&D sector. However, it is unlikely, for political and budgetary reasons, to expand that sector. Only the removal of the American security umbrella over Japan, coupled with the emergence of a strong and identifiable threat, would force the country to consider fundamental changes in its strategic culture. In the final analysis, Japan is prevented more by political and cultural constraints than by technological

[41] . n. 39, p. 110.

ones from transforming itself into a power that can take advantage of the RMA.

Most of the countries in the rest of the world will remain unconcerned by the warfighting implications of the RMA as it pertains to their immediate security, given that their neighbors are just as unlikely to take advantage of it. However, there are those countries that are thoroughly disconcerted by the RMA, particularly those that feel they might become targets of U.S. power projection. Unfortunately for these nations, it seems that the military technological gap between "the West and the rest" has become a yawning chasm. Many of these countries have sought an asymmetrical response to the widening gap between their conventional capabilities and those of the United States. This asymmetrical response lies in the acquisition of weapons of mass destruction-chemical, biological and nuclear. Such countries realise that they cannot compete in the arena of high-technology conventional warfare, so they require other means with which to deter U.S. intervention in a regional conflict and make U.S. involvement as costly as possible.

Chapter Two: RMA today

Throughout history, there have been a number of military revolutions. Gunpowder produced an early military revolution in the Western World, transforming both land and naval warfare. During the mid-nineteenth century, industrialisation revolutionised warfare through railroads, the telegraph, the steam engine, rifled guns, and ironclad ships. More recently, the mechanisation of warfare during the interwar period led to the development of blitzkrieg, carrier aviation, amphibious warfare, and strategic bombing.[1]

To date, the bulk of the intellectual and physical development associated with the current RMA has focused on new systems and technologies. What is needed now is a more careful analysis of the new operational concepts and new organizations that might best help us realise the full potential of these new systems and technologies. To reach that level of analysis, we need to start with an appreciation of the historical and geostrategic contexts in which the RMA may unfold.

---

[1] . Mary C. Fitzgerald, " The New Revolution in Military Affairs". *RUSI Whitehall Paper Series* (London), 1994, p. 64.

RMAs: past and present

Very briefly RMAs in the past have risen from various sources, with many but not all of them technological. Societal change contributed to a military revolution during the wars of the French Revolution and the Napoleonic era, in which the *levee en masse* allowed for the creation of larger, national armies. In the technologically based military revolutions of this century, different scientific fields have provided the enabling factor. For example, chemistry and early physics drove many of the critical advances during World War I. In this war of gunpowder, the rate at which weapons fired and the ranges that the projectiles travelled decided the fate of many battles. Advanced physics drove the next RMA, which extended from the mastery of fight to improve radios and the introduction of radar through the creation of nuclear weapons at the end of World War II.[2]

The current RMA has as its source what has been called new physical principles. These principles focus on technologies such as lasers and particle beams. Current trends indicate that the next revolution in military affairs may have a biological source. Some manifestations of these biological advances may include biosensors, bioelectronics, nanotechnologies, distributed systems, neural networks, and performance-enhancing drugs. New technologies and systems significantly influence the RMA, although the resulting RMA could take one of a number of forms.

---

[2] . Alvin Toffler and Heidi Toffler, *War and Anti War,* Little Brown (Boston), 1993, pp. 29-30.

The interwar innovations of armoured warfare by the German army, amphibious warfare by the US Marine Corps, carrier warfare by the US Navy, and strategic bombing by the US Army Air Forces have been characterised as "combined-system RMAs." Their revolutionary nature is derived from a collection of military systems put together in new ways to achieve a revolutionary effect.[3]

A present trend reflects the emergence of multiple new warfare areas. A warfare area is a form of warfare with unique military objectives and is characterised by association with particular forces or systems. Examples of warfare areas that emerged in the interwar period are armoured warfare, carrier warfare, amphibious warfare, and strategic bombing. We have currently identified four new potential warfare areas incorporate: long-range precision strike, information warfare, dominating maneuver, and space warfare. In the four potential new warfare areas precision strike is most developed conceptually, although even here much analytic work remains to be done. Analysis of dominating maneuver and space warfare has just begun and information warfare has yet to be understood in detail.

[3] . Willamson Murray, "Thinking about Revolution in Military Affairs", *Joint Forces Quarterly* (Washington D C), Summer 1997, pp. 69-70.

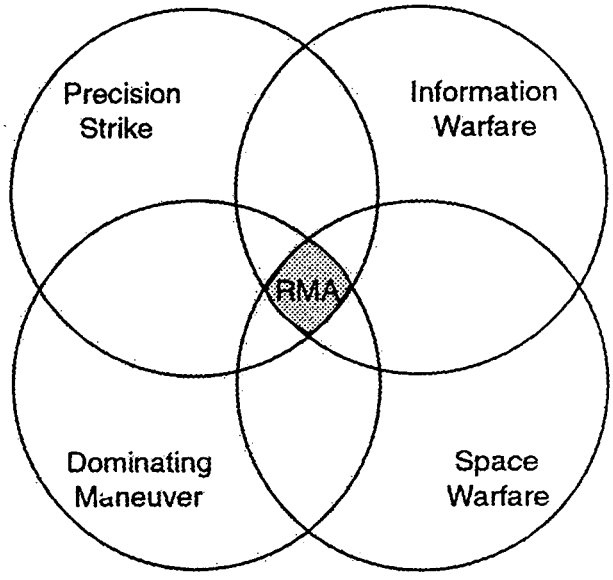


Figure 1. Elements of the Present RMA

Figure-2

The warfare areas that have been identified are likely to emerge in the long run but will not necessarily be developed fully in the near future. Doctrinal development is a long and uncertain process, and military history offers numerous examples of unexploited warfare areas, concepts intended to revolutionise warfare that did not come to fruition. Technological limitations, conflicts with prevailing doctrine, or lack of strategic purpose have derailed these developments.

Precision Strike

Precision strike may well be the most thoroughly understood as a new warfare area of the next revolution in military affairs. The creation of precision strike capabilities during the latter stages of the Cold War in fact cast a long technology shadow and deeply affected Soviet military thought.

Precision strike in the context of the coming RMA is well beyond its predecessors of Follow-on Forces Attack (FOFA) and joint precision interdiction, which are its conceptual forebears. At the time of the development of such precision strike systems as the Joint Surveillance Target Attack Radar System (JSTARS) and the Army Tactical Missile System (ATACMS), the idea was to create a maneuver differential for NATO ground forces.

The Gulf War demonstrated the potential for such deep strike systems not only to create a maneuver differential, but at least potentially to be decisive in themselves. Precision strike, in the context of the unfolding RMA, is the ability to locate high-value, time-sensitive fixed and mobile targets; to destroy them with a high degree of confidence; and to accomplish this within operationally and strategically significant time lines while minimizing collateral damage, friendly fire casualties, and enemy counterstrikes. In J.V 2020, precision strike technologies will create the potential to achieve strategic effects at intercontinental distances. [4]

The precision strike area of warfare presents a significant challenge to the organisational adaptation of the US military. These systems achieve decisive impact only if they are integrated at the operational or strategic level of war. This means that a single theater or global commander must have control over the employment of precision strike systems, as was done during Desert Storm. The essence of precision strike is the ability to sense

[4]. Eliot A. Cohan, *Gulf War Air Power survey Summary Report*, Washington Institute for Near East Policy (Washington D C), 1993, p. 103.

the enemy at operational and strategic depth, recognise his operational concept and strategic plan, and select and priorities attacks on enemy targets of value. All of this is intended to achieve decisive impact on the outcome of the campaign. To be most effective those attacks probably should be synchronised in time and space.

The revolutionary potential of precision strike derives from the technologies that provided a glimpse of their own potential during Operation Desert Storm. These and related technologies enable commanders to have continuous wide-area surveillance and target acquisition, near-real-time responsiveness, and highly accurate, long-range weapons at their disposal. Such technologies by themselves have the potential to change dramatically the way wars are waged. Integrating precision strike capabilities with dominating maneuver and information war may create an especially potent RMA.

By 2020, real-time responsiveness of sensor-to-shooter systems may become a reality. For the first time in history, this responsiveness will allow the striking force to maneuver fires rather than forces over long ranges, and allow direct and simultaneous attack on many of the enemy's centers of gravity. Advances in technology are currently driving this warfare area. The key improvements that are now occurring are in broadening the environmental conditions for wide area surveillance and precision targeting, security and counter-measures, data processing and communications, delivery platforms, precision munitions, and

positioning/locating devices. The advances needed to exploit our lead in this warfare area include continuous situation awareness and improvements in data fusion, mission planning, and battle damage assessment (BDA).[5]

At the same time, US need an equal effort in developing new operational concepts and organisations for the application of precision strike. As in other new warfare areas, it is possible that the greatest military payoff will come from operational approaches and organisational adaptation, not from systems.

Information Warfare

Another revolution under way in warfare has been driven by information systems, their associated capabilities, and their effects on military organisations and operations called information warfare, which is defined as the struggle between two or more opponents for control of the information battlespace. At the national level, information warfare could be viewed as a new form of strategic warfare, one of the key issues being the vulnerability of socio-economic systems, and the question is how to attack the enemy's system while protecting yours. At the military operational level, information warfare may contribute to major changes in the conduct of warfare, therefore, focusing on the vulnerability of command, control, communications, and intelligence systems.

---

[5]. Paul Bracken, "The Military After Next", *Washington Quarterly* (Washington D.C), 16, no. 4, Autumn 1994, p. 157.

It is not clear at this time whether information warfare measures taken by a potential adversary at the outset of a war would be readily detectable. The question of how you know you are at war may be difficult to resolve in view of the potential ambiguity associated with information warfare. Ambiguity and plausible denial are not new phenomena. But the rapid growth of interconnections manifested already in communications, banking, and other areas creates vulnerabilities and presents opportunities to do grievous harm--quickly, with no warning, and with a minimal "signature". Accordingly, the analysis of indications and warning that mark the outset of warfare must change. To date, insufficient thought has been applied to this aspect of the character of future war. In addition to its inherent ambiguity, information warfare in 2020 also portends a very different set of potential responses by the United States to an adversary detected acting in a hostile or potentially hostile fashion. [6]

Although countering an adversary's command and control has always been a feature of warfare, the United States has been somewhat invulnerable to such measures. One clear implication of warfare in 2020 is that almost any enemy will try to degrade our information system. Paradoxically, although the technology of information systems is becoming more capable and sophisticated, it is actually harder to secure the information infrastructure from attacks.[7]

---

[6] . Ibid, p. 158.

[7] . Ibid.

In dealing with the information revolution that is affecting the military today, the US military services seem to be engaged in improving their current communication channels. That is, they are striving to improve performance elements within the current organisational structure. They have yet to address the implications of systems and capabilities that do not fit within the current structure. This is a fundamental issue. The military traditionally has viewed information services, including intelligence and communications, as supporting inputs to the actual warfare functions of fire, maneuver, strike, and the like.

Dominating Maneuver

One of the more recently identified potential new warfare areas is dominating maneuver. Maneuver has always been an essential element in warfare, but the RMA potentially offers the ability to conduct maneuver on a global scale, on a much-compressed time scale, and with greatly reduced forces. Dominating maneuver is the positioning of forces–integrated with precision strike, space warfare, and information war operations–to attack decisive points, defeat the enemy center of gravity, and accomplish campaign or war objectives. While precision strike and information warfare are destroying enemy assets and disrupting his situational awareness, dominating maneuver will strike at the enemy's center of gravity to put him

in an untenable position, leaving him with no choice but to accept defeat or accede to the demands placed on him.[8]

Dominating maneuver is distinct from maneuver in several ways. Maneuver refers to the "employment of forces on the battlefield through movement in combination with fires, to achieve a position of advantage with respect to the enemy in order to accomplish the mission."[9] Dominating maneuver refers to the positioning of forces, not necessarily their employment, they can be positioned anywhere in a theater, not necessarily on the battlefield. It goes beyond "combination with fires" by integrating its effects with the effects from precision strike, space warfare, and information warfare. Its ultimate purpose is directly to achieve campaign and war objectives, transcending the role of ordinary maneuver. Dominating maneuver does not require superiority at all points in the battlespace or imply domination of the entire maneuver. By 2020 U.S competitors could well challenge US national interests in regions where they enjoy the advantage of close proximity, and United States may have neither a lengthy build up period to marshal their forces nor access to a continental infrastructure to support their forces in the theater.[10]

---

[8] . M. Thomas Davis, *Warfighting Transformation – A Slow Moving Process*, Rosslyn: briefing slides, Northrop Grumman Analysis Center, August 25, 1998, p. 34.

[9] . US Department of Defence, *Directory of Military and Associated Terms*, 1 December 1998, p. 218.

[10] . Ibid, p. 219.

Dominating maneuver could allow ground forces to operate successfully in situations where they cannot dominate the entire battlespace. The concept has a number of other implications for operations, organization, and technologies as well. First of all, dominating maneuver will require new operational concepts that take into account the decisive importance of time, making future maneuver more simultaneous than sequential. It will be essential to attain operational and strategic objectives through simultaneous information warfare, space warfare, precision strike, and maneuvers against the enemy's critical points rather than through a series of pitched battles against enemy forces.

To execute dominating maneuver in 2020, the United States will have to develop new means for the movement of ground forces. The development of forms of mobility not possessed by the enemy could help generate maneuver dominance. More advanced concepts for comparable forms of mobility also could give a decisive advantage, as the Germans demonstrated in May 1940. The Germans generated maneuver dominance on the ground by employing combined-arms units that could mass combat power quickly, supporting them with fast- moving "aerial artillery" in the form of close air support, stressing aggressiveness, developing a faster command and control system to establish C^2 dominance, and employing air interdiction to degrade Allied mobility.[11]

---

[11] . Ibid, p. 222.

The Germans intended to use their maneuver dominance first to attrite the Red Army and then to seize Moscow, whose capture would sever the Soviets' transportation network and paralyse their political apparatus. Despite their maneuver dominance, the Germans failed–largely because of their logistics, which were inadequate to the needs of supporting far-flung advances over the vast distances of the Soviet Union. Future attempts at dominating maneuver may similarly come to grief as a result of shortcomings in logistics. The dual imperatives of mobility and logistics may create the need for smaller forces and new transportation technologies. The current Strategic Mobility Study has as its objective the intercontinental deployment of a heavy brigade in 15 days and a heavy corps in 75 days. In the future, the United States may require the ability to move a corps-equivalent force across the oceans in seven days or less. This capability might be achieved through the exploitation of new transportation technology such as fast sea transports capable of 100 knots or more, the national aerospace plane, and supersonic transports, through organisational changes creating smaller units with useful combat power that could deploy faster or be forward-deployed on naval platforms, or through ways not yet conceived.[12]

The United States may need new technologies if it employs such tactics and seeks to maintain the lead that its forces possess in close combat. As advanced sensors and conventional weapons technologies proliferate and

---

[12] . Ahmed S. Hasim, "The Revolution in Military Affairs outside the west", *Journal of International Affairs* (New York), Columbia University Press. Winter 1998, p. 40.

provide greater stand-off ranges for enemy forces, the United States should concentrate on achieving capabilities that will allow it to leap ahead of these developments.

Space-Based Warfare

The US military's increasing reliance on support from space-based systems for its everyday operations and especially during times of conflict has highlighted the importance of space operations. However, space assets could provide more than support for the terrestrial war fighter in the future. The space environment offers the possibility of conducting worldwide military operations in a greatly reduced time frame.

The evolution of space operations is comparable to the development of air warfare. Aircraft played an essential role in supporting the ground and naval forces in the First World War through observation, antiobservation, ground attack, and communications. Between the wars, larger aircraft came into service in the form of civil and military transport, a capability that was greatly expanded during World War II. Moreover, between the world wars the United States and Great Britain developed airpower as a means of leapfrogging conventional ground and naval battles to enable direct strikes on the enemy's ability to wage war. Although this theory of strategic bombing met with limited success in the Second World War, the concept

culminated in the development of the intercontinental nuclear deterrent after the Second World War.[13]

Space operations, like air operations in the First World War, currently provide support essential for the successful operations of terrestrial forces. Satellites enable near-real-time, worldwide communications, sensing, timing, and navigation. These capabilities, analogous to the roles of the observation balloons and aircraft of the First World War, may make possible dominant battlefield awareness and coordination of a global precision strike architecture. An Effective Antisatellite capability could lead to the ability to achieve aerospace control or superiority in order to deny an opponent the ability to operate in or from space.

Space operations will, however, greatly differ from air operations. First, the "geography" of space is fundamentally different from that of the earth's atmosphere. Orbital mechanics require operating speeds (17,000 miles per hour) that far surpass those currently achievable in the atmosphere. Thus, if properly placed and employed, space assets could perform missions in much less time than state-of-the-art aircraft. One possible mission is to use space forces to project power to directly achieve national objectives (operational or strategic) in a particular theater. Space strike systems based on satellites or on transatmospheric vehicles could enable precision strikes

---

[13] . *Space History 1 – The Evolution of Space Power*, Federation of American Scientists, February 2000, p. 4.

whose quantitative advantage in speed would result in a qualitative difference in capability.[14]

Space, however, does have limiting factors that could constrain its military use. First, space is not amenable to human life, thus limiting the manned presence in future space operations. As a result, most of the improvements in future space operations will most likely come through unmanned technologies. In addition, the speeds associated with space flight and the amounts of fuel required to maneuver in orbit using current technologies and energy sources greatly limit the flexibility of spacecraft in orbit. Therefore, sizable technical hurdles have to be overcome before space-based strike, antisatellite systems, spacelift, and space transport becomes militarily usable capabilities. Systems that could enable future space operations might include Trans-Atmospheric Vehicles (TAVs), Single-Stage-to-Orbit (SSTO) launch vehicles, space-based Directed-Energy Weapons (DEW) or Kinetic Energy Weapons (KEW), space-based Ballistic Missile Defense (BMD), satellite defence systems, small satellites, and both space-based and ground-based distributed networks to reduce the vulnerability of space capabilities.[15] New technologies such as new materials to reduce weight, more heat-resistant and stress-resistant materials, and sources of energy–more powerful and efficient than chemical reactions–may be are required to make these systems truly effective.

---

[14]. Ibid, p. 5.
[15]. Ibid, pp. 5-6.

Implications: Dominant Battlespace Awareness

One potential result of RMA may be the ability to generate Dominant Battlespace Awareness (BDA) over a particular enemy, in a particular conflict. This awareness would not magically provide perfect intelligence, but would allow the United States to detect all observable phenomenology while limiting the enemy's knowledge. This information would translate into the ability to know force locations and characteristics (including distinguishing between targets and decoys and among target types) at all times. Furthermore, the BDA architecture could include mechanisms for disseminating this data directly to the appropriate strike systems and conducting constant Battle Damage Assessments (BDA).[16]

An advantage such as DBA would probably require a large percentage of the total US sensing, analysis, and data transmission assets. As a result, to generate dominant battlespace awareness for a given conflict would require borrowing from both national assets and those dedicated to other theaters. In the collection arena, the constant monitoring required may increasingly emphasise airborne and terrestrial sensors rather than space-based platforms. We may well see stealthy Unmanned Aerial Vehicles (UAVs), flying at very high altitudes, conducting a greater share of the collection duties than do manned aircraft.

---

[16] . Edward Waltz, *Information Warfare Principle of Operations*, Artech House Norwood MA (London), 1998, p. 133.

A capability such as DBA could affect both the systems the United States fields and the operational concepts designed to employ them in such a conflict. One likely implication may be that a force with a greater number of long-range strike systems, tied to DBA, would be far more lethal in attriting enemy forces than would traditional forces. Thus, the efficiency of US precision strike campaigns could increase substantially as current problems such as prompt targeting, selection of the proper munitions, reallocation of assets, and near-real-time BDA begin to dissipate. On the other hand, a force designed to maximize the impact of DBA might exacerbate some difficulties faced by today's forces. First, the volume of targets made available through DBA could simply overwhelm US strike capabilities. A force heavily weighted toward long-range precision-strike weapons may not completely overcome this problem but may still provide an order-of-magnitude increase in the force's lethality. Second, such a fire-intensive force will require a very large inventory of munitions. Both of these problems, last seen in the Gulf War.[17]

Dominant Battlespace Awareness may also provide benefits that extend beyond simply increasing the effectiveness of long-range strikes. For example, another force structure implication of DBA may be the ability to truly do more with less. If DBA can tell us where the main axis of attack is coming, we may be able to use smaller forces to blunt the attack because they will be covered more effectively by fire support, and the commander will have the ability to commit reserves precisely where and when they are

[17]. Ibid, pp. 134 – 135.

needed. This could lead to much improved exchange ratios and the opportunity to direct certain assets against other high-value targets much earlier in a conflict.

At the same time, we would have to recognise that there would be several categories of targets where DBA would not have a large impact. One example may be a country with large inventories of Nuclear, Biological, or Chemical (NBC) weapons. Use of these weapons may take the form of limited chemical attacks on ports and airbases or could even include nuclear attacks against US forces. Almost certainly, DBA will not help the United States gauge the enemy's intentions vis-à-vis NBC use. Furthermore, the deep underground targets that typically house NBC systems and infrastructure would be impossible for DBA to penetrate.

Another potential area in which DBA's impact may be limited is close battle. Even after a highly successful attrition campaign, US forces may inevitably run into residual enemy forces on the ground and the resulting battle may be too confined for DBA-cued fires to be of much utility. Nevertheless, if the above implications are borne out, DBA could allow the United States to defeat an enemy quickly and with fewer losses as compared to the present option.

Russian Blueprints for the RMA

In the early 1980s the soviet military-under the propulsion of Marshal N.V.Ogarkov- was the first to argue that a new 'revolution' was occurring

in military affairs. Today the Russian military argues that precision-guided, non-nuclear, deep-strike weapons and the systems used to integrate them are revolutionsing all aspects of military art and force structure. According to the Russian military, superiority in the new RMA proceeds form superiority in C^4ISR systems i.e. reconnaissance, surveillance, and target acquisition systems, and the 'intelligent' command-and control systems. Information technologies are now said to be 'the most formidable weapons of the twenty-first century' – and comparable in effects to weapons of mass destruction. Indeed they constitute the essence of the new RMA. The Russian politico-military leadership therefore recognised long ago the imperative of engineering a dramatic shift away from material-intensive systems and toward science-intensive systems: away from ballistic missiles, submarines, heavy bombers, tanks and artillery and toward advances C^4ISR and EW systems.

According to Russian military scientists, such as General-Major V. Slipchenko, Vice-president of the Academy of Military Sciences, warfare has evolved through the following five generations: (1) infantry and cavalry without firearms, (2) gunpowder and smoothbore arms, (3) rifled small arms and tube artillery, (4) automatic weapons, tanks, military aircraft, signal equipment, and powerful new transport means, and (5) nuclear weapons. The impending sixth generation of warfare, with its centerpiece of superior data processing to support smart weaponry, will radically change military capabilities and, once again, alter the character of warfare. Future wars will see smart conventional weapons destroying precisely

located targets and limiting casualties while defeating the enemy militarily and politically with, in most cases, rejecting need to occupy enemy territory. Military operations will be space-based with greatly expanded command and control, electronic and air defence warfare, automated data communications and reconnaissance capabilities.[18]

Slipchenko notes that the next 10 or 12 years are expected to produce significant armaments and military equipment developments that will lead to radical changes in the character of war. As the latest precision weapons under development and testing enter the inventory, changes in the structure of armed forces and the forms and methods of their employment will follow. In addition, the development of other types of remits will continue, also entering the inventory but the turn of the century: directed energy automated high-precision weapons systems, more powerful explosives, deep-penetration ammunition and, of course, super high-speed data-processing and electronic warfare equipment. Space will become a new theatre of military operations, even as the superpowers significantly reduce offensive nuclear weapons. These nuclear weapons will be replace be non-nuclear strategic offensive weapons.

Gradually, large ground force operations and nuclear missiles will recede, being replaced by high-precision conventional weapons. 'Sixth–generation warfare', say the Russians, has changed the laws of armed combat and the principles of military art – very coordinates of war. In wars of past

[18] . Colonel G.P. Otyutskiy, *Apropos of the Essence Military-Technical Revolution*, VM, no.2, 1998, pp. 52-53.

generations, the main efforts of the warring sides were confined to the earth's surface: the width and depth of offensive or defence, the vertical coordinate (primarily air) was auxiliary or only supporting. But in future wars, the emphasis will be reversed. The main efforts in future-armed combat will be concentrated on the vertical or aerospace coordinate, and efforts on the ground will become supporting. Past wars relied on ground forces to achieve victory by routing the enemy's armed forces and destroying his economic and political system. This involved extensive casualties and required occupation. It will be enough to use non-nuclear strategic offensive weapons to inflict serious losses on the enemy's most important military and economic facilities and counterattack assets. While the role of ground forces is receding into the background, the spotlight is now on the air force, navy, air defence, and information warfare.

Russia's military-technical policy:

In 1997 the Russian Defence Minister, Igor Sergeyev, forecasted that the equipping of the Army with new armaments and hardware will begin gradually after the year 2001. "If we do not provide modern armaments and military hardware for the army, it will become an exhibition Army", he said.[19] A large-scale war is hardly possible in the near future, but in the long-term future the danger of the outbreak of such a war will grow because of the depletion of energy resources in the world. Many

[19] . Interview with Russian Federation Defence Minister Igor Sergeyev by Igor Korotchenko, "Igor Sergeyev: A Team of Like-minded People is Working in the Defence Ministry." *NG*, 17 October 1997, pp. 1-2.

technologies which are declared promising by the officials of the Russian military-industrial complex also have a guaranteed lag since Western forms have been engaging in these developments on the basis of military orders from their governments for several decades now. They Include primarily the radar stations of the future (the qualitative improvement of onboard radar including phased-array radar to intercept airborne targets), facilities for detecting submarines and associated technologies (the study of the ocean noise condition and the mission of low- and very low-frequency acoustic waves in the water), and optical-electronic instruments (the improvements of infrared reconnaissance sensors, the development of solid-state lasers and small-scale gas laser).[20]

Other priority technologies for the Russian military-industrial complex include structures from composite materials (the developments of new composite materials and structures from them including light-weight armour for tanks and naval equipment, new heat-resistant composite materials for use in gas turbine engines and for aerospace equipment), microelectronics components made of silicon (the modernisation of commercial silicone integrated circuits for military purposes), the raising of reliability and resistance to radiation, modular aircraft electronic equipment (including radar, navigation and communication apparatus, reconnaissance and electronic warfare facilities), and space observation facilities (primarily

[20] . Yevgeniy Krutikov, "Only a Tank 'The Size of a Cat' Has a Chance of 'Catching Mice'," *Segodnya*, (P&P) 25 June 1997, p. 3

high-resolution optical systems, space radars with synthesized apparatus, and real-time data-transmission systems).

Then First Deputy Defence Minister of Russia, Kokoshin once boasted that the programme of military development up to the near 2005 would provide Russia with 'weapons that have no counterparts in the world'. It is to this aim that the 1700 research centers of Russia's military-industrial complex are working. Rearmament of the army will have to be begin after 2005: it is planned each year to update up to 5 percent of army arms and equipment and to complete rearmament of the army by 2005. Overall, by 2005, the structure of expenditure should look like this: 60 percent of the funds will go on maintenance, logistics support, and troop combat training (today 70 percent of the funds go on maintaining the army), and 40 percent will go on research and development work and the purchase of armaments. A selective approach has allowed Russia to create a number of vehicles, ships and systems in high demand on the world arms market.[21] All these areas are missiles aircraft technologies, nuclear and shipbuilding. Despite the systems crisis, which Russia is experiencing, the country still retains leading positions in a number of science-intensive directons.

[21] . Denis Baranets, "12 Billion for Weapon That No One Has", *Komsomol'skaya Pravda*, (Moscow) 7 August 1997, p. 11.

China's Military Modernisation

China's efforts to manage the RMA are a part of a larger process to modernise the People's Liberation Army (PLA). Military modernisation is only one of the elements of China's central four modernizations. Beijing's timeline to achieve economic development extends until 2049, or 100 years after the founding of the People's Republic, when it aims to reach a level of the 'moderately developed countries'. This extended period to pursue economic modrnisation is based on the assumption announced by Deng Xiaoping in 1985 that world war is no longer imminent. Without an immediate major threat to China's national security, military modernisation can be conducted at a measured pace appropriate to the nation's level of economic development.

RMA technologies are expected to play a greater role in Chinese military doctrine in the future, but the PLA is unlikely soon to be transformed completely into a state-of-the-art fighting machine.[22] Nevertheless, the US and China's neighbours must continue to monitor how PLA can employ these technologies effectively enough for Beijing to accomplish its national objectives through the threat or actual use of military force.

According to David Finkelstein, 'the programmes under the 'Two Transformation' must turn the '*operational requirements*' of the high-tech

---

[22] . B. Gill and L. Henley, *China and the Revolution in Military Affairs*, Strategic Studies Institute, Carlisle Barracks *PA*: US Army War College, 1996, p. 27.

battlefield into *'operational capabilities'*.[23] The Chinese leadership has adopted Local War under Modern High Technology Conditions as the direction for future doctrinal development. (As will be seen, no such formal commitment has yet been made to the RMA.) Local War is defined as short-duration, limited warfare fought on China's periphery using joint and combined arms forces, employing high technology weapons in the air, on land and in sea (surface and subsurface) as well as in the electromagnetic spectrum and possibly in space.

China's management of its military modernisation process and the incorporation of aspects of the RMA into this process are dependent upon several variables, only some of which are under the direct control of its military leaders. These variables include:

- Resources devoted to the military,
- Reform of China's defence industrial sector,
- The research and development sector(R&D), and
- The education level of its citizenry and soldiers.

At the same time, the Chinese military leadership has authority over the transformation of the PLA's organisation and structure, the revamping of its doctrine, and the creation of a spectrum of integrated systems that seeks to maximize the performance characteristics of the modern weapons entering the PLA's inventory. Indeed, acquition of new weapons is

[23] . D. M. Finkelstein, " China's National Military Strategy", in J.C Mulvenon and R. H Yang (eds), *The People's Liberation Army in the Information Age* (Santa Monica Rand), 1999, p.135.

probably the least important aspect of China's military modernisation, though it receives the greatest attention from the foreign media. For China, military modernisation and the RMA are as much a mental process, a change in the way of thinking about warfare, as they are a question of hardware and technologies.

Mark Stokes recognises existing operational shortfalls as:

- Missiles are rapidly becoming the sole credible long-range firepower projection asset which the PLA has in its inventory, and this will likely remain the rule for the foreseeable future,
- PLA Air Force foxed-wing assets remain the weak link in guarding China's airspace,
- China has been slow to develop a space-based reconnaissance capability and,
- The PLA strategic community is working furiously to develop information warfare doctrine and concepts.[24]

Long before RMA concepts became a topic of interest for the PLA, certain decisions about modernisation had been made and had begun to be implanted. The sheer size of the PLA mandated that the entire force could not be modernised at once. Therefore, a few units were selected to receive new equipment, increased training, and conduct doctrinal experiments. This process of selective modernisation resulted in the formation of rapid reaction units, which are capable of responding to contingencies within China along is periphery, and what has become known as 'pocket of excellence' within the PLA, such as some of its missile forces. At the end of century, the PLA finds itself in the midst of:

---

[24] . M.A. Stokes, *China's Strategic Modernisation: Implications for the United States*, Strategic Studies Institute, Carlisle Barracks, *PA:* US Army War College, 1999, pp. 35-36.

- A reduction in size to about 2.5 million personnel, which will result in the elimination several major headquarters and division-size units,
- An expansion of its reserve forces and the paramilitary People's Armed Police force,
- Experimentation with a brigade-based ground force structure (3000-5000 personnel) in lieu of the traditional division-sized organisations,
- Retirement of large numbers of old, obsolete aircraft, ships (especially submarines), and armoured vehicles,
- The introduction of limited amounts of more advanced weapons, from small arms to nuclear-tripped missiles, into some units,
- A change in the period of conscription so that all conscripts now serve for only two years of active duty, thus necessitating changes in the unit personnel replacement system, the system of training new soldiers, and retention of greater numbers of soldiers to act as non-commissioned officers,
- Improving living standards to help maintain morale,
- Training reform that incorporates greater use of computerised simulators and 'force-on-force' exercises,
- The development of improved systems for reconnaissance, surveillance, and intelligence command and control and logistics, and
- Doctrinal transformation to fight Local Wars using joint and combined arms forces.[25]

If successfully executed, these elements of military modernisation will enhance the PLA's ability to conduct Local War as well as contribute to its RMA capabilities.

China's Defense Paper 2002 was released in December 2002. It is the fourth such Paper since 1995. It clearly affirms that the top priority for China is to continue its modernisation. In particular, economic security is given more attention. It has three major goals:

- Preparing for a new form of warfare in the future.
- Securing a stable regional environment for China's continuing development.
- To engage in multilateral and regional institutions based on stronger economic and military strength.[26]

---

[25] . Ibid, pp. 39-40.

[26] . Vincent W. Chen, "China Defence Paper 2002", *Strategic Analysis* (New Delhi), Vol.XXV no. 2, April-June 2003, p. 292.

Yet, China still very much resents the existing economic order whose norms, procedures and rules China regards as having been unfairly set up by developed countries. To deal with those kinds of issues, China realises that it needs to continue economic development and modernisation its armed forces to have a say in international affairs. However, to what extant China is able to change the rules of international economic and trade regimes remains to be seen, particularly when it has also become a member of the WTO.

Military Modernaistion of Japan:

Despite sever financial difficulties, Japan has entered the new millennium as an economic superpower. It is the world's second largest trading nation and enjoys a GDP second on the world only to that of the United States. Moreover, Tokyo's military muscle has grown dramatically in recent years. The country's armed forces now control fifty-eight warships, sixteen submarines, 330 combat aircraft and roughly 1,100 main battle tanks. This enormous accretion of power, along with Tokyo's willingness to play a more active role in the maintenance of regional peace and stability, is making some of Japan's neighbors nervous.

The Self-Defence Forces

The Prime minister of Japan serves as the commander in chief of the SDF. He appoints minister of state for defense who exercises general control over

the JDA (an external agency of the prime minister's office and everyday SDF activities. Like the prime minister and all other state ministers, this official must be a civilian.

Within the cabinet, a security council has been established to deliberate on important defense matters a coordinate policy during national emergences. This body also submits the SDF's budget and other important legislation related to defense to the Diet for its approval.[27] In theory, the Diet exercises the ultimate control over al SDF activities–the power of the purse. In practice, however, it tends to ratify compromises already hammered out by Japan's leading political parties, the JDA, and various over government ministries. Since the 1950s, Japan has been building up its defense capability in line with the Basic Policy for National Defense and other basic policies. At the present moment, the SDF is attempting to comply with those modifications outlined in the *New Taiko*:

- Streamlining the SDF's defense capability and making the organisation more compact
- Making qualitative improvements in the SDF enabling it "to be able to effectively respond to a variety of situations".
- Ensuring that the SDF is flexible enough "to deal with the development of changing situations." [28]

---

[27]. Johns E. Endicott, *The Defense Policies of Nations: A comparative Study,*: John Hopkins University Press (Baltimore), 1994, pp. 365-366.

[28] . Japan Defense Agency, *Defense of Japan,* (Tokyo: Defence Agency) 1997, p. 122.

Ground Self-Defence Forces

Security analysts have described Japan's GSDF as "the best balanced of the three services in terms of combat capability, save that of strategic or even major tactical mobility."[29] After the changes mandate in the New Taiko are completed, it will be equipped with one amoured division, one airborne brigade, one helicopter brigade, eight antiaircraft artillery groups, and fourteen regionally deployed GSDF units (eight divisions with 6,000 to 9,000 personnel and six brigades with 3,000 to 4,000 personnel). Force levels will be cut from 180,000 to 160,000 authorised troops (145,000 regular personnel and 15,000 ready reserve personnel).[30] The GSDF will continue to be supported by modern domestically manufactured Main battle tanks armored vehicles, missiles, and helicopters. In keeping with basic Japanese security policies, the GSDF's training is directed toward defense rather than offence.

Maritime Self- Defence Forces

The chief objective of the MSDF is to defend Japan "against sea-borne invasion and protect maritime traffic on the seas surrounding Japan.[31] The

---

[29] . Brian Cloughley, "Japan Ponders Power Projection," *International Defense Review* (Tokyo), 1 July 1999, p. 27.

[30] . n. 28, p. 107.

[31] . Ibid, p. 108.

JDA has warmed that an obstruction of the sea-lanes surrounding Japan "would have serious consequences on its people's livelihood economic activity and the substance of its defence capability and raise a serious difficulty in receiving aid from the US."[32] It is the MSDF's responsibility to secure that safety of maritime traffic to the distance of 1,000 nautical miles.

During the Cold War, the structure of MSDF emphasized anti-submarine and mine warfare. However, the *New Taiko* calls for a "more balanced" force that will be able to cope "with anti situation which might threaten the safety of maritime traffic vital to the security of Japan.[33] It is anticipated that the MSDF will be able to conduct "a variety of operations ranging from surveillance and patrol on surrounding sea areas to such public welfare support as disaster relief activities.[34] In operational terms, the number of destroyer divisions, minesweeping flotillas, and land-based patrol aircraft units is being reduced. However, naval equipment will continue to be upgraded, training will be accelerated, and force levels will remain constant at roughly 42,000.

Air Self-Defense Forces

Japanese defense planners comprehend that, given the nature of modern warfare, it is highly likely that any invasion of Japan could be preceded by

---

[32] . Ibid, p. 109.

[33] . Japan Defence Agency, "*A New Era in Defense*", (Tokyo: Defence Agency) in the world wide web at http://www.Jad.go.jp/pab/kougo/taikou

[34] . Ibid.

and air attack. For this reason and because the SDF adheres to a passive defense policy, the JDA contends that "it is imperative for Japan to have an air defence capability highly capable of instantaneously responding to an invasion o its air space."[35] In addition to defending the nation against attack, the ASDF is supposed to maintain a capability to "carry out under the Japan-US security arrangements."[36]

Like the other branches of the SDF, the ASDF is a force in transition. The aircraft control and warning units are being reorganised and the number of fighter squadrons is being reduced form thirteen to twelve.[37] New equipment also is being introduced. The ASDF is acquiring several E-767 Air Warning and Control System (AWACS) aircraft form the united Sates. Col. Kunio orita, AWACS program manager for the ASDF, explains that the new spy planes are needed because "our existing radars do not give us the ability to monitor low-flying aircraft either over land or sea, so we had to provide long-range coverage that would fill in this gap"[38] It also plans to ultimately acquire midair refueling aircraft that will provide Japanese warplanes with a greater range of operations. [39]

The Japanese government consistently emphasized that civilians–not military officers–would exercise control over the JDA and SDF. And

---

[35] . Ibid.

[36] . Ibid.

[37] . n. 28, p. 124.

[38] . Peter Grier, " AWACS Land in Japan," *Air Force Magazine*, (Tokyo) 98, p. 12.

[39] . Ginny Parker, " *Japan Strengthening its forces*," Associated Press. September 10, 1999, p. 10

Tokyo announced in 1976 that it would prohibit the export of arms. This meant that Japan's substantial defense sector was dependent upon domestic military requirements.

Recently Japan defence policies following 11 September are set out in the Japanese Defence Agency's 2002-Defence of Japan report. Self Defence remain the guiding principles and the importance of Japan's special defence relationship with US is emphasized in particular by reference to continuing Joint US – Japanese research into ballistic missile defence systems.

On 2nd December 2001, the Diet passed the 'Anti-Terrorism special Measures Law' to permit the deployment of Japanese defence assets in support of US in its campaign against al-Qaida and Taliban. The Japanese Defence Agency is working on policies to cope with biological attack and has set up a biological-weapon countermeasures committee. Chemical and cyber attack also have high priority in defence planning. In terms of Defence technology the emphasis is on the development of high-technology weapon system, Cyber protection and network and C^4ISR systems.

Most nations in the rest of the world are lagging behind in the development of advanced conventional military power. There is much scepticism about other countries' ability to transform their large and unwieldy conventional forces into high-technology forces that can exploit at least some areas of the RMA. Many countries in the rest of the world have been importers of weapons and not producers. They simply do not have the scientific and technological base to produce major weapons, let alone high-technology

weapons. They have an advanced civilian high-technology industrial infrastructure that can produce the new information technologies that are contributing to the RMA.

Military powers in the rest of the world have shown a marked inability to wage conventional war effectively, as their fighting technique is characterised by the domination of land warfare and a systematic inability to use the other branches of the military, namely air and naval power, effectively. Often jealous of one another and fighting for a bigger share of the defence budget, services in many countries do not seem to cooperate much. Very few countries in the rest of the world will achieve this kind of jointness, because it requires organisational flexibility and a decentralised system of command and control. Some nations, thoroughly disconcerted by the RMA, have sought an asymmetrical response to the widening gap between their conventional capabilities and those of the United States. This could be through the acquisition of weapons of mass destruction- chemical, biological and nuclear. Such countries realise that they cannot compete in the arena of high-technology conventional warfare, so they require other means with which to deter U.S. intervention in a regional conflict and make U.S involvement as costly as possible.

Chapter three: Indian Armed forces and the RMA

The Indian RMA scenario is not very comfortable, because as it stands, the Indian military has been a way behind the technical driven wars of the 21st century. With Indian Military planning, bereft of cohesiveness and prone to knee jerk reaction, procurement would not match emerging technologies and will gradually lose the race in the advancement technology of the future, if radical measures are not initiated. On the other hand the Defence Industry has remained where it was decades ago, with overstaffed ordinance factories barely managing to run with Government subsidy, notwithstanding a captive buyer like the Indian Military. As such, they will find almost a century. The availability of cutting edge technology to the armed forces would be difficult and it is certain that technologically advanced nations would not oblige India to the effect. Broadly speaking, Indian RMA will depend on the following:

- Strategic systems, which are essential for the country's defence but are not available.
- Systems and Technologies, which leapfrog into bridging the gap with technologies likely to be developed in the future.
- Integration of the command and control network of the three services.
- Synergy between the Services and Defence Research and Development Organisation (DRDO).

- Effective utilisation of the technologies available in the private sector.

Research and Development

The Indian Military has embraced the indigenous scientific and technological developments in various fields, to be incorporated in their operational planning, which are as follows:

Remote Sensing Satellites: Indian remote sensing satellites may be among the best ones circling the earth at present. The Imagery is much better than the SPOT and other Landsat group of satellites. As of late 2000, five IRS satellites were in the orbit and more are scheduled to join this family. The Indian space Research Organisation (ISRO) and its commercial arm Antrix corporation Limited successfully launched the IRS-1D the Earth Imaging Satellite on 29 September, 1997, from Sriharikota, which is similar to IRS-1C. These dual use satellites provide 5.8-meter resolution images to customers, twice as often as was possible with just the IRS –IC. This would benefit the three services immensely. This resolution, which as of early 1998, is the best among the civilian remote sensing satellites in the world and is superior to the 8-meter resolution initially reported for the panchromatic imager. [1]

[1] . C. N. Ghosh, "Satellites and space Application", *Indian Defence Review* (New Delhi), vol. 16 (2) April-June 2001, p. 46.

IRS-P4 (OCEANSAT-1): Following the above, IRS-P4 was launched with payload of Ocean Colour Monitor (OCM) device which is a solid state camera operation in push broom scanning mode, using linear array Charged Coupled Deices as detectors. This camera has 8 narrow spectral bands with a spatial resolution of 360 mtrs, and swath at 1420 km. As ISRO explains, since OCM is designed to provide the highest spatial resolution among the contemporary ocean colour sensors with unique regional and global coverage and it is expected to provide ample opportunities/ application potentials for scientific, commercial and military.[2]

Imagery Intelligence (IMINT) and Military Application Satellites: The Satellite Imagery, Battle Damage Assessment etc, helped military planning immensely on day-to-day basis in both Gulf and Kosovo wars and may have prompted the Defence Services to come to an understanding with the ISRO and plan the future defence application satellites. [3]

Unmanned Combat Aerial Vehicles (UCAV): Experience of the Gulf and the Kosovo war brought several strategies to the forefront and the supremacy of air power has been clearly established. It has been established that air power made it easy for the ground forces to complete the annihilation of the Iraqi Army. That's why the war strategies do no have any doubt that some form of air power will decide the course of the battles

---

[2] . Ibid.
[3] . Ibid, pp. 46-47.

in future. Such deliberations naturally bring the factor of Unmanned Combat Aerial Vehicle (UCAV) in the forefront. UCAV has not only the attraction of keeping combat casualties low but overcomes many human limitations too. UAVs will be smaller, faster and more agile than manned fighters. Such unmanned vehicles could be used in preference to manned flights in a dense air defence battle space optimized by low looking radars and QRMs (Quick Reaction Missiles).[4] These will be very useful to Keep a long vigil on the enemy activities and pass information to the command post. UCAV concept is technically feasible. These can meet the operational need and fit into a sound plan of operations. Historical biases for manned aircraft should not be the stumbling block for embracing this technology in the futuristic technology driven wars. These forces need to be understood and application made accordingly. And this was adequately proved during the recently concluded Afghan war. The predators of US Sir Force carried Hillfire Anti-tank missiles and were controlled by ground crew effectively. Following the success of the Predators, the Global Hawks were pressed into service for surveillance and communication in Afghanistan. Indigenous UAVs are under development by DRDO. Before these are made available to the Services, Indian Air Force has taken a step in the right direction by inducting UAVs like Searcher II and Herons to its inventory through procurement route

[4]. Ibid.

Defence R&D

Defence R&D is being handled entirely by Defence research and Development Oraganisation (DRDO). This organisation will have to work very hard to meet the future requirements of the armed forces in this century. A viable match between DRDO capabilities and the demand of the armed forces should emerge to resolve the demand supply crisis. Mutual understanding, penalty driven MoUs, and user/DRDO interface would be the requirement of the future. The R&D in the core sector has to be given an impetus. Increment of the DRDO budget is not only the answer. Financial assistance, in the terms of MoUs, needs to be formulated with in the DRDO and with the civil industry as well. India is neither short of manpower or brainpower. It lacks appropriate direction.

DRDO has grown over a period of last 40 years or so and handles the entire defence related R&D. Self reliance could be with the help of scientists of this organisation. Some of the important areas where DRDO has excelled are given below:

1) **Millimeter Wave System:** MM wave technology has been the intellectual property right of the advance nations. DRDO's efforts to harness this technology will assist guidance and control of airborne

military sensors, through large gain channel bandwidths. This field will be critical to force multiplier systems. [5]

2) **Radar:** Phased Array radar, apart from others, which has been developed by DRDO, should be in consonance with the present generation requirement of the armed forces. This radar has significant advantages over other control and guidance radars. [6]

3) **VLSI and Microwave monolithic Integrated Circuits (MMIC):** A commendable achievement by DRDO was to develop MMIC. Another critical technological breakthrough, which would help development of EW equipment, is very Large Scale Integration (VLSI).[7]

4) **Lasers:** Lasers have assumed great importance because of their wide-ranging applications. DRDO is in the process of developing high power laser weaponry and other laser related technological innovations.[8]

---

[5] . C. N. Gosh, *Future Defence Challenges*, Manas Publications (New Delhi), 2003, p. 34.

[6] . Ibid.

[7] . Ibid.

[8] . Ibid, p. 35.

5) **Missiles:** The Integrated Guided Missile Development Programme (IGMDP) has been a success story. Prithvi has already entered the service with both Army and Air Force. On 9 January 2003, India tested an *Agni-1* tactical SRBM, with a range off some 700 km. The missile weighs 12 tons, can carry a one-ton nuclear warhead, and is designed to be launched form mobile platforms that can operate on railway tracks or roads. The *Agni-1* bridges a gap between the 2,000 km, *Agni-2* and the 150-200 km *Prithvi*, both of which are in service.[9]

The *Agni-3*, with a range of over, 3000 km is a solid fuelled mobile system with inertial navigation and carries one-ton warheads and the enhanced range of *Agni-3* will give India the capability to reach beyond Chinese border areas. Meanwhile, Indian government scientist's claim that New Delhi can develop ICBMs with ranges in excess of 5,000 km due to the successful space programme of GSLVs (Geocynchronous satellite Launch Vehicles) and PSLVs (Polar satellite Launch Vehicles). January 2004, three different missiles were flight-tested. They are *Akash*, *Trishul* and *Nag*. Recently, India tested the *BrahMos* anti-ship cruise missile in February 2003, to improve its air defence capability with the *Akash* SAM system.[10]

---

[9]. Ibid.

[10]. India's Defence Modernisation, *Strategic Digest*, IDSA (New Delhi), Vol. 35 no. 4, May 2004, p. 470.

6) **Aviation:** The Indian Air Force collaborative effort to fly Light Combat Aircraft (LCA) has seen the first prototype in the air this year, with the American sanction being removed the aircraft should receive the right push to get into squadron service. Remotely Piloted Vehicle (RPV) this project is also in the last stages of development. It should soon be included in the active service and similarly the Advanced Light Helicopter (ALH) should be able to reach the production stage shortly. [11]

5) **Core Material:** Steps have be taken to produce leading edge material like AL-lithium alloy, ultra high strength steel, titanium alloys, carbon ceramics, and ceramic composites, etc. However, cost and commercial viability would be required to be taken into account and if necessary start up subsidies provided.[12]

6) **Electronic Warfare Systems:** India has launched a global search for an electronic warfare system (EW) for its Army, tailored for operations in Jammu and Kashmir and the North-East, despite being in the advanced stages of the indigenous *Samyukta* EW program. Under the $200 million program slated for 2003-2004, the Army will purchase equipment that can detect, record and jam

---

[11] . n. 5, p. 36.

[12] . Ibid.

communications equipment operated by terrorist groups and Pakistani troops operation on the border. The Army's *Samyukta* EW program, developed by the DRDO, is a part of that effort. Samyukta has 10 active aperture phased array radar, 100 digital communication signal systems and about 50 very-high-frequency electronic jammer systems, in the 1.5-to-500-megahertz-range. [13]

Requirements of Indian Military in the 21st Century

Indigenous scientific achievements, no doubt, would assist Services to incorporate them in their operational planning and force structuring, but the following developments must be taken into consideration by Indian Military for them to achieve RMA in the real sense.

Sensors: Sensors are nothing but physical entities, which convey information about external environment from the sensing domain by using hardware and software. These are designed to interact with the sensing domain with the user or machines to which the sensor provides information and schemes for producing, storing and analysing the information threat, the sensors gather. Advancements in the sensor technology are increasingly creating opportunities to coordinate the operation of individual sensors in ways that produce significant operational benefits. This needs a

[13] . Jasbir Singh, *Indian Defence Yearbook –2004*. Natraj Publishers (Dehradun), 2004, p. 308.

fundamental and comprehensive examination if sensor requirement and their deployment. Constant development of the system, keeping the cost factor into consideration, would be essential.[14]

The growing need for sensor derived information, coupled with limited number of systems in an affordable force structure, creates ever growing demands for the performance of sensors technology and has been making rapid strides.

Electro Magnetic Pulse Bombs: During the Kosovo war a Tass wire story reported for the first time about the presence of a new weapon being tested by the USA. This was the most secret weapon designed to destroy the radio electronic equipment. The Russians also went on to report that these bombs were dropped by B-2 stealth bombers to generate Electromagnetic Pulse (EMP). Russian Defence Minister told the Tass reporters that the US was using Yugoslavia as a test range or its latest secret means of destruction. The existence of the weapon has not been denied by the US. Some other countries like Taiwan have also been noticed while carrying out to assess the capability of such a weapon in recent months. [15]

---

[14] . Kapil Kak, "India's Defence Modernisation", *India's National Security Annual Review* (New Delhi), February 2001, p. 311.

[15] . Ibid, p. 312.

The electromagnetic pulse is, in fact an electromagnetic shock wave. The EM energy produces such a storm of electromagnetic field that it produces short lived transient voltage of thousands of volts (Kilovolts) on exposed electrical conductors like wire or conductive tracks or printed circuits boards wherever exposed. The idea would be to immobilise the enemy before destroying him. Information flow is to be strengthened for own side and stopped for the enemy.

The weapon can be delivered by a cruise missile or by any other stand off platform and exploded within yards of the target. The explosion would be followed by generation of high power microwaves that can disable electronic circuitry in computers and communication equipment. This EMP could erase software and destroy computers.

For a military man, it wouldn't be an easy task to identify targets for the electromagnetic bombs because of the complexity of the entire system. It may be easy to identify certain targets but to match the bomb capability with the target may not be easy. Building, housing, various government departments and installation areas are easy to locate and target because of their geographical location and can be attacked provided the aircraft can penetrate to the weapon release point and height. Mobile and camouflaged targets like air defence radars, missile complexes, mobile troops naval vessels over the high seas are also good examples of the target system that can be attacked with E-Weapons. Like any conventional warheads, an E-

bomb could be fitted on a cruise missile, conventional missile, or on an aircraft. However, like all other weapon systems, E-weapons also suffer from their inherent limitations. Despite being an area Weapon, the E-Weapons would demand better accuracy for their delivery because it would be important to illuminate the target area completely, to achieve the best results.[16]

Directed Energy Weapons: While talking about RMA, Kapil Kak, IDSA mentioned that, ".... Technology change may well revolutionise warfare in the 21st century. Countries that can exploit emerging technologies and synergies the same with innovative operational doctrines and organisational adaptation could doubtless achieve far higher levels of relative military effectiveness."[17] That is why it has become necessary to discuss and understand the impact of DEWs. These weapons are at a very advance stage of development and can prove to be more dangerous and lethal than anything seen or experienced before. The directed energy weapons neither make any noise nor do they inform about their deployment. The super observation capability of a nation may discover the design of an adversary but it would be very difficult to determine the time and direction of their effectiveness.

---

[16] . Ibid, pp. 312-313.

[17] . Kapil Kak, "Revolution in Military Affairs", *Strategic Analysis* (New Delhi), Vol. XXIV no. 14, April 2000, p. 2.

A complete paradigm shift in the military aspects would be expected when the Laser and Particle Beam Weapons would be added to the military inventory. The cyberspace-based technologies supported by the DEWs on future conflict might inflict unacceptable damage sufficient to alter the course of the conflict. The airborne laser system is being deployed by the USA recently with the capability to destroy a missile with a range beyond 120 km at the boost phase. The space based laser or particle beam weapon capable of punching a hole in any missile at a range of 3000 Km is under active development. Nuclear doctrines, mutually assured destruction, limited response, CTBT and MCTR etc, would lose their relevance in the backdrop of the silent revolution of DEWs.

Precision Guided Munitions (PGMs): PGMs are among the most important systems driving the RMA ahead. In India, some progress has been made towards infrared or command guided missile systems, but Indian capability to produce indigenous systems like laser-guided bombs is very limited. The only alternative would be to stockpile the same and ensure a steady supply at the time of crisis.

In the Gulf war it was estimated that 10 percent of munitions were PGMs. In the war of Kosovo, the majority of US bombs were laser-guided variety, which ran into trouble due to bad weather. On the contrary in Afghanistan the bombs were all weather and satellite guided. The Joint Direct Attack Munitions (JDAM), a guidance kit fitted to the ordinary iron bombs, transformed it into an accurate munitions using satellite linked global

positioning system to guide it to the target. Though it was less accurate than the laser guide bombs.[18] Yet, the advantages of the same are that these are much cheaper and can be dropped by a wider range of aircraft.

Command and Control: The thrust area for the Indian armed forces in command and control would be to improve the graphic display of terrain in terms of image capture, image processing, resolution and speed, Portability of imagery data from one medium to another with the desired degree of resolution and Data fusion techniques to cater for inputs from a large number of different types of systems. [19]

The Human Element of India's RMA

No revolution can ever be complete, without bringing the human element within the loop. Whether it is a man-machine match or sensor to shooter match. It all depends upon the individual to understand the complexities of the future scenario and act correctly and make no mistakes. In addition to the capabilities and technologies inducted into war, attention must be paid to the development of the quality manpower for future military operations. Age-old traditional military will be at a loss in this changed scenario unless it is ready to accept and learn the complexities of the situation. Human computer system integration is a vital requirement. That is why the future defence personnel need have to be well trained, and undergo a different

[18]. Ibid, p. 3.

[19]. Ibid.

type of training in addition to their traditional trainings, which may seem complicated at the outset but the machinery, if fine-tuned, would resolve the issue appropriately. They would have to control and work with machines and information system in the most efficient manner and be mentally and physically superior to the opposing forces. Considering the fast moving nature of the future battlefield, the human factor should not be a limiting factor for the commander, otherwise the RMA would be a lost case. As a result information overload for the human being has to be relieved by introducing voice recognition and choice generation, gesture recognition and responses. For a successful revolution in Indian military affairs, consistent human engineering will be an urgent requirement for cost-effective human-machine fusion.

RMA and Defence Allocations

The Parliamentary Standing Committee on Defence has expressed its distress at the under-utilization of defence allocation, particularly in respect of capital expenditure, continuously for the last several years. The quantum of under-utilised funds becomes more glaring if comparison is made between the budget Estimates and the actuals in the preceding years. The Committee found that the Kargil tax was diverted to the General Fund, meaning thereby the funds collected for the specific purpose of national security had become the part of general revenues of the government.

The governments levied a 5 percent surcharge on taxpayers for national security during the year 2002-2003. It also levied a surcharge of 10 percent for the same purpose on taxpayers earning more than Rs 8.5 lakh per annum during 2003-2004. Thus Rs 4,253 crores were generated in 2002-2003. In 2003-2004 a sum of Rs 2,800 crores was likely to be collected. [20]

Non-Lapsable Modernisation Fund

The Committee has recommended that funds collected from the national security surcharge must be placed in a separate "non-lapsable" fund to be utilised but the Ministry of Defence for capital expenditure. Capital expenditure includes expenditure on land, construction works, plant and machinery, equipment, tanks, naval vessels, aircraft and air-engines, dockyards, etc. Expenditure on the procurement of heavy and medium vehicles as well as other equipment, which have a unit value of Rs 2 lakh and above and a life span of seven years or more, also come in the category. The defence secretary informed the committee on 9 December 2003 that a Defence Modernisation Fund was on the anvil, which will be available for utilisation over a three year period from Financial Year 2004-2005, since defence acquisitions were a time consuming affair and could not be compressed within a period within a period of one fiscal year.[21]

---

[20] . R. K. Jasbir Singh, *Indian Defence Yearbook –2004*, Natraj Publishers (Dehradun), 2004, p.290.

[21] . Ibid, pp. 290-291.

The Defence Ministry in the last two years (2002-2003) failed to spend more than $2 billion within specified budget years due to delays in negotiations or approval of acquisition deals, and was forced to return the money to the government. Some of the major defence deals in the pipeline include the $1.6 billion Scorpene submarine deal with France, which is awaiting clearance from the Indian Cabinet, acquisitions of Multibarrel Rocket Launcher system, Smerch from Russia, worth $600 million, acquisition of the Admiral Gorshkov aircraft carrier from Russia, a deal worth $1.5 billion, including the Mig-29K aircraft on board, upgrades to the Army's T-72 main battle tanks, and the acquisition of 155mm guns.[22]

The 2004-05 defence budget of $14.59 billion is slightly higher than that allotted for the 2003-04 cycle. In that year alone, the Defence Ministry surrendered $1.3 billion of its $14.33 billion budget. This new budget calls for $4.89 billion for new weapons and equipment from the domestic and overseas markets, up slightly from the $4.56 billion for acquisition programs in 2003-04, according to budget documents. Spending on research and development has been nearly doubled for the coming year to $360.4 million, compared with $198 million this year (see table no. 1). Some of the development programs being carried by the Defence Research and Development Organisation include the *Trishul* and *Akash* theater missile systems, Agni-3 medium-range missile, and naval, land and air

[22] . India's Defence Budget, *Strategic Digest*, IDSA (New Delhi), Vol. 34 no. 4, April 2004, p.573.

electronic warfare systems, along with limited production of *BrahMos* cruise missile.[23]

Table no. 1

India's military Budget (2003-2005)

Allocations in Defence Fund	Year 2003-2004	Year 2004-2005	Difference
Total Defence Budget	$14.33bn	$14.59bn	$0.26bn
Acquisition	$4.56bn	$4.89bn	$0.33bn
R & D	$198bn	$360.4bn	$162.4bn
Army	$1.23bn	$1.76bn	$0.53bn
Air Force	$1.54bn	$1.52bn	$-0.2bn
Navy	$1.47bn	$1.1bn	$-0.37bn

Source: *Strategic Digest* (IDSA, New Delhi), April 2004.

The Army gets $1.76 billion for procurement in this (2004-2005) budget year, compared with $1.23 billion in the year ending March 31, 2004 (see table no. 1). Some of the major Army programs for the coming budget year

[23]. Ibid, pp. 573-574.

are much the same as this year, and include T-72 tank upgrades and modernisation of the BMP-II infantry-fighting vehicle, as well as to buy infantry weapon systems, T-90 tanks, special mobility vehicles, unmanned aerial vehicles (UAVs) and military communications systems. [24]

The Air Force gets $1.52 billion for acquisitions, down slightly form $1.54 billion in 2003-04 (see table no. 1). Some of the service's major defence programs are the acquisition of advanced jet trainers, UAVs, low-looking transportable radar and short-range quick-reaction missiles, as well as upgrades for MiG-21 and MiG-27 combat aircraft. [25]

The Navy receives $1.1 billion, compared with $1.47 billion for the last year for new equipment and weapons (See table no. 1). Major programs include the *Gorshkov* carrier deal and MiG- 29K naval combat aircraft.[26]

India's 5-Years Plan (2002-2007)

Between 2002-2007, India plans to nearly double defence spending compared to 1997-2002, which is expected to see completion in may, means that spending is about to balloon. Only $28 billion has been spent since 2002 began. The five-year spending plan includes:

- $58.7 billion for the Army, including $15.6 billion for new weapons and equipment.

---

[24] . Ibid.

[25] . Ibid.

[26] . Ibid, p. 576.

- $32.5 billion for the Air Force, with $11.75 billion for procurement.
- $7.6 billion for the Navy, with $4 billion for procurement.[27]

Before we each five year plan is drawn up, the services send their five years spending priorities to the Defence Ministry, which sends its recommendations to the Finance Ministry and Planning Commission. After the commission approves the plans, the Finance Ministry disburses the funds in annual allocations to the Army, Air Force and Navy. The prime minister chairs the commission, which lays down the planning processes for the government.

Army

By 2007, the Army expects to upgrade more than 2,500 Russian T-72 and T-55 tanks, buy around 600 155mm guns, light armored vehicles and mine-detecting vehicles, and begin licensed production of Russian T-90 tanks, and simulators for the artillery and infantry. Around $5 billion will be spent on ammunition, including smart bombs. The South African firm Denel is helping India establish a factory to, make 155mm shells. There is also a proposal to develop smart munitions for the 130mm and 155mm guns at the state-owned Ordnance Factories in collaboration with Israel Military Industries, Rama Hasharon, Israel. These new facilities to be built at private

[27] . Ibid.

and state owned companies will ensure speedier and regular supplies of spare parts and ammunition for Russian-built equipment.[28]

Air Force

The Air Force intends to buy 66 Hawk 100 Advanced Jet Trainers from London-based BAE SYSTEM, six tankers form Uzbekistan, and other combat aircraft, especially multirole planes. The service also expects to upgrade 125 MiG-21 bis, MiG-27 and MiG-29 fighters and AN-32 transport aircraft, and spend $1 billion to mount Israeli Phalcon radar on Russian-built Il-76s, giving India Airborne Warning and Control System aircraft. The services also intends to buy:

- Foreign-made fifth-generations missiles to allow all of its planes to fire on targets beyond visual range.
- Simulators for the service's aircraft and aging air defence system.
- 24 aerostat-mounted radars to detect and strike targets[29]

Navy

The new five-year plan will buy and refit the retired Russian aircraft carrier Admiral Gorshkov for $1.5 billion under a January 20 contract that will give India's Navy a second carrier. The Navy also will buy stealth warships

[28] . Ibid, pp. 576-577.

[29] . Ibid.

marine surveillance aircraft, submarines and the *BrahMos* cruise missile, and lease backfire bombers from Russia. Beyond the three services, the 2002-2007 spending plan includes $8 billion for defence research development of ballistic missiles, including the vertical-launch *Trishul* and *Akash* ballistic missile defence systems, the *BrahMos*, Precision-guided munitions and 3,000 kilometers-range *Agni-III.* [30]

Joint Services Operations

The RMA can be applied only in joint operations. The army alone cannot launch an operation under the RMA. There is no such thing. The RMA automatically means an air-land battle that follows the gaining of air superiority. Until 1990, there was only one India Joint force capability relevant to the RMA, and that was DIPAC. Fortunately, this organization has grown impressively under a rotating tri-service command. Today the TES satellite conveys to all three services vital strategic information but broadband connectivity between DIPAC and commands, as well as formations below the command level is till years away. Part of the reason for this it that an integrated staff was put in place only at the end of 2001. But whether the staff can make up for poor management over the years depends on whether the integrated staff gets its own budget for expenditures on tri-service broadband connectivity.

---

[30] . Ibid, pp. 577-578.

Satellite imagery, as well as photo-recce information must be taken away from a Delhi–centric set up and made available directly to the user through a central C^3I system. The scientists have done the armed forces proud this time by making available the TES, but poor joint services connectivity threatens national security today, by denying the man at the sharp end what the satellite picks up. There are a number of other issues, which only the integrated staff can solve. For instance, to operate the Army in a RMA environment, J-stars aircraft are imperative. But it is quite unlikely that most general officers in responsible positions cannot even give the QRs for J-stars, nor would Army Headquarters agree to fund a squadron of such aircraft. The British have already solved their problem, with the air force funding the aircraft, the army the equipment inside, and the navy the ground terminals, which are located on board the new LPDs. If the J-stars have to be flown by the air force, but revolutionize land warfare, who will pay for them? It is simple bureaucratic obstacles like these that prevent India getting modern joint force capability. Let us not forget that the 'who will pay' question even crippled the acquisition by India of laser designators without which the Afghan war could not have been won by the USA.

Surveillance satellites, communication satellites, transporter photoreconnaissance, laser designators, broad band C^3I to disseminate satellite and recce data, and J-stars are all in the area of tri-service budgeting. The integrated staff must be given the money for all this before

the allocations are made for the three services. Once this change is made in the budgeting rules, genuine RMA may begin to take place. [31]

Special Orientation

Anyone who saw a special operations soldier of the US walking along with the Northern Alliance, summoning strike aircraft from carriers in the Arabian Sea or B-52s from Masirah or Diego Garcia and beating back the Taliban world understand the nature of future low intensity warfare. In an era when Indian forces have no laser designators, this gadget was standard fitting on all Special Forces weapons in Afghanistan. Despite being the victim of terrorists fraps 12 years, India is yet to launch a cross border Special Forces operation. The reason for this is that providing night flying troop-carrying helicopters is not an Air Force charter ever since the Army took over rotary wing aviation. Hence, the benefits of Special Forces operations to achieve the RMA are not available to India. Few remember that Special Forces undertook the destruction of Iraqi radars on the southern frontier prior to Desert Shield. Indian inability to field Special Forces in pursuit of national goals is directly attributable to single service pressures that prevent this from taking place. This is a strong accusation but true, where a single service mistakes its interests above those of the nation. The ability of the MoD or the Parliamentary Committee on Defence or strategic

[31] . The USA uses a mission statement to justify tri-service funding for the RMA called, *Joint Vision 2010*. There is also a *Joint Vision 2020*.

thinkers to force integration on service headquarters on the Special Forces issue would be the best beginning to breaking the logjam.

Role of CDS

With the submission of the Task Force Report on Defence Management the events seem to have completed a full circle Mr. Arun Singh, Advisor (Security), Ministry of External Affairs, who headed this Task Force-handed over his recommendations to the government in end September 2000. Some of the important recommendations were on structures of defence decision-making that is the reactivation of the Defence Minister's Committee (Which the present Defence Minister has activated in 1998), creation of an organisation of the Joint Chiefs of Staff (JCS), assisted by the Vice Chief of Joint Staff (VCJS) and so on. The role and missions of the CDS for the Indian armed forces in summation, therefore, these are:

- Principal military advisor to the Government after having consulted the tree Service Chiefs. The CDS would also be responsible for evolving a joint doctrine for the Indian armed forces.
- Develop policy advice for the Government and after receiving defence policy guidance from the Government (based on clearly

enunciated National Security Strategy), evolve a joint National Military Strategy.

- Responsible for issuing instruction for joint operations and when new joint organistion are formed for prosecution of specific joint operations, to special command and control of such organisation.
- Exercise command and control of strategic forces through the Command HQ (Whenever it is set up). Such command and control responsibility should extend to any joint command whenever it is set up for some specific purpose.
- Responsibility for exercising command of various newly proposed inter-services agencies like the Defence Intelligence Agency, Defence Logistic agency, Organisation of for developing inter-services network and the C^4I^2 systems and so on. The CDS would be responsible for inter-service organisations including joint training establishments. [32]

Jointmanship

In the battlespace of the future, where wars would be fought in many dimensions and media, the practice of jointmanship would be absolutely essential for achieving success. The word jointmanship is not found in the dictionary. The other words used to convey the same meaning are

[32] . Jasjit Singh, "Higher Management of Defence: The Case for Reforms and Their Direction", *Frontier*, February 24, 1999, pp. 90-91.

"Jointness" and "Jointery". The word jointness conveys the meaning of things having been forcibly joined to joined together or structures with joints and jointery is another word, which is in the lexicon of the British military literature, though the British do not consider this word to be particularly elegant. However, the essence of all these terms is an inter-service cooperation for synchronisation of all components of military power to achieve a common military aim. Jointmanship is characterised by trust and confidence, mutual respect for each other's capability and cooperation, rather than competition. The nature of the modern and future battlespace milieu makes it imperative for our armed forces to fight an integrated battle. In our context, the concept of jointmanship envisages the conduct of air-land, air-maritime and tri-national security objectives. The Indian Air Force Doctrine lays down the following four essentials for jointmanship. The Army Doctrine also subscribes to these views. These essentials are:

- Trust and confidence, resulting form sincere efforts to learn about and understand the capabilities and limitations that each member brings to the team.
- Operating on the bases of partnership and mutual respect of each other's capabilities.
- Cooperation with each other rather than competition. It may be well worth remembering that the competition is with the enemy.

- Finally, joint operations involve using the right time and not necessarily a bit of everything. [33]

If the RMA is to be imposed on a reluctant service, the best method is to impose the RMA through the integrated staff. As warfare changes, single service operations become weaker and more irrelevant without joint service facilities. Satellite surveillance, satellite communications, joint EW and joint photo interpretation have already begun to shift to the integrate staff along with the DIA. However, the integrated staff, after a year of functioning is coming up against single service prejudices once again. This wouldn't matter if the integrated staff has its own finance, which should come to it before the single service allocation is made. The revenue costs of whatever the integrated staff command costs, continue to remain in single service budgets. For instance, the revenue costs of the strategic command would be borne by a single service and this will become the pattern of the future, if the integrated staff gets independent future.

[33] . *Doctrine of Indian Air Force*, Air Force publication. October 1995. pp. 106-107.

Chapter Four: India's information warfare capabilities

RMA presents a different set of approaches to the concept of warfare, in which the armed forces do not act alone. It functions in co-ordination with other agencies thus integrating its capabilities of gathering information and using it to one's advantage. RMA also presupposes a corresponding change in the security establishment and the force structure. Especially to build capabilities for information warfare, there is need too have better surveillance and intelligence collection, especially on the borders, and an extra eye on the fissiparous movements. Technologies can enhance these, but more than science, the determinant of success would be how the available information is organised, given a coherent form and put it to the best use.

In the debate on knowledge-based warfare, various terms are used to conceptualise this new shift in focus on things other than mere military hardware, nevertheless vital ingredients in a military operation and eventual victory. Terms like C^3I, C^4I, etc are used in this context, to analyse India's capabilities in the field, one such coinage is taken, namely, C^4ISR. It means Command, Control, Computers, Communications, Intelligence, Surveillance and Reconnaissance. India's capabilities and vulnerabilities in each of these key areas will be discussed in this chapter.

Command and Control

In the nineties, there were strong debates on the need for changing the command and control system of the army. The new warfare would be a joint endeavour in which not just all services of the army, but police and paramilitary forces and the intelligence apparatus will play crucial roles. The present structure, with each arms of the defence forces developing their own command and control system hierarchies would not suit such a concept of war. Therefore, strong arguments were made in favour of changes in the higher defence set up. After India went nuclear with the Shakti Pokhran tests, the need to have a nuclear command, incorporating land, sea and air-based delivery systems was felt for which a proper command and control system had to be put in place.

Especially, given India's service legacies and the rigid hierarchical system of the armed forces structure, it was not easy to change traditional mindsets. India's efforts and far-effecting changes at the top notch did not meet with much success, as the personality clashes often prevailed over innovative application of the emerging possibilities of warfare. One such issue was the attempts to create a Chief of defence staff (CDS).

A CDS is needed to provide a single advice on defence matters such as threat perceptions, strategies, forces levels, equipment and manpower policies. CDS would also issue joint military operation related training and logistics directives and respective services would continue to provide

advice to CDS with respect to their service. But those who argue against jointness cite the reasons of India's specific security scenario. General V. N. Sharma once said, "I do not understand what role the Navy will play, if there is an integrated theatre command in Kashmir."[1] In 1990, the Arun Singh Committee had suggested some path-breaking recommendations on decision-making, planning, management and financial control in the defence forces.

It suggested the reactivation of Defence Minister's Committee, (which was done in 1999) creation of the Joint Chiefs of Staff Office, and integration of service headquarters with Ministry of Defence and integrated theatre commands. Though these proposals were generally accepted, the resistance came from the civilian bureaucracy. Political establishment has also shown indifference to the decision-making structures of military. Service chiefs generally operated on individualistic lines than jointly, each preoccupied his own perception. The proposal for Chief of Defence Staff (CDS) was a therefore, result of over decade of debate on the issue of management of higher defence, for a single-point advisory and control for the entire armed forces. As the key military adviser to the government and a point of co-ordination between and three services, CDS was also meant to co-ordinate India's nuclear forces. The Union Cabinet decided to accept the group of Ministers' recommendation for a CDS. But the inter-service rivalries came

---

1. Vinod Anand, "Achieving Synergies in Defence", *Strategic Analysis* (New Delhi), Vol. XXII no. 10, Jan 1999, p.1450.

into the forefront when the naval chief's name, who was the senior-most among the three service chiefs, was not supported by the Air Force.[2] Airforce has been opposing CDS as it feels that the post could decentralise its air assets its role as a 'strategic force' would be marginalized and also air power will be treated just as a support arm for the future land operations.

In its highly classified 'Vision 2020', IAF suggested that the nuclear air command should be created with all delivery systems (missiles) placed under its disposal rather than that of the CDS. The paper suggested that the army neither require nor may have a nuclear role, and even if it felt the need for a nuclear submarine for the navy, the aim was too far away to be ralised. CDS, it is thought, would be the permanent chairman, Chiefs of Staff Committee (COSC), far more powerful than any individual Chief of Staff. Chairman of COSC can take decisions only if the other two service chiefs concur. However the IAF thinks that the CDS will be influenced by the background from where he comes and it will therefore try to introduce another layer in the decision-making ladder. The CDS was expected to assess and command the strategic forces and the newly constituted Defence Intelligence Agency for the Government. There is a prevailing perception that the CDS can liquidate the powers of the service chiefs. There are also

---

2. Shishir Gupta, "Down to Brasstacks", *India Today* (New Delhi), 28 May 2001, pp. 44-45.

political wrangles; with their major opposition from the Congress saying that the CDS has larger ramifications for the defence establishment.

Instead of a network-centric warfare, there are many who believe in centralisation, as they think it would bring economy of effort. They argue that India's limited air assets and the flexibility of IAF's long-range power can be best exploited by using them centrally rather than frittering away air resources and dividing them between theatre commands.

As the debate on such far-reaching changes at helm of command and control continues, the concept of CDS is being tried at Andaman and Nicobar, with a tri-service organisation headed by a Joint Chief of Staff. Creation of a Strategic Command and Control of nuclear weapons is essential. A joint organisation in the form of a Joint Strategic Command with components from all services and involved civilian agencies would positively achieve synergies of operations. But as discussed earlier, airmen and soldiers seem to have different perspectives and sense of primacy. Air doctrine tends to emphasis the strategic role of the IAF, importance of Counter Air Operations (CAO) over Offensive Air Support (OAS) with greater desirability of battle air interdiction as compared to close air support.

In the Indian context, ideally all operations would need to be joint air-land operations and in certain theatres it will include the Navy too. The

distribution of air effort between CAO and OAS would have to be jointly planned, based on visualised operational scenarios and situations. A tri-service exercise Trimph-98 was carried out in 1998, which indicated the understanding in the services about joint training as an important ingredient for winning future wars. In India, certain geographical areas would need a tri-service approach while in most theatres, a two-service approach is sufficient.[3] However, the Cabinet Committee on Security (CCS), informally created in 1997, takes the crucial decisions regarding security.

The National Security Council, set up by a parliamentary decision in 1990, has mostly remained a non-starter, often referred to as a tower of Babel, with different members articulating different viewpoints.[4] But on actual ground, however it is the CCS, which looks after the management and decision-making in national security-related matters. A 30-member National Security Advisory Board (NSAB) has not been heard of much, since its inception. Capabilities of military are not only related to development of hardware, but also to the lack of organisational capacity within armed forces and civil areas of the government. Until the problem of overall organisation and higher direction of armed forces is addressed and

---

3. Kapil Kak, "Management of India's Security and Higher Defence", *Strategic Analysis* (New Delhi), Vol. XXII no 3, June 1998, p. 327.

4. Janaki Bahadur Kremmer, "In the Tower of Babel", *Outlook* (New Delhi), 1 February 1999, pp. 45-46.

overcome, India's military capabilities in the context of modern warfare are likely to be less than those suggested by the inventories at its disposal.[5]

Communication and computers

Communication:

Knowledge-based warfare emphasised by the new RMA is largely dependent upon proper military communications. Information Technology has revolutionised the capability of human beings to communicate across limitations of geography and time. This has led to a renewed attention on improving the communication facilities of the defence establishment. Military communication requirements are peculiar and challenging, as they demand very high standard of reliability, raggedness, and sustenance in extreme temperatures. The end-to-end secrecy is also a great imperative.

Now with the opening up of economy and liberalisation of policies, India's private industry is offering high-tech communication systems and the defence forces are gearing up to seize this opportunity. Software-driven electronic and processing intensive systems are required for Indian Military communications establishment to fill in the existing voids and to match the adversaries whose acquisitions have kept pace with the unprecedented growth in the electronic and Information Technology sectors. India's present inventory of military communication appears to be outdated even in

---

5. Sandy Gordon, *India's Rise to Power in the 20th Century and Beyond*, Canberra: St Martin's, 1995, p. 345.

the face of state-of-the art low cost options, which have permitted into civilian sectors. The Kargil Review Committee has recommended modernisation of communication interception equipment and augmentation of direction finding equipment (Recommendation no.6). It suggested the establishment of a single organisation like the National Security Agency of the USA, grouping together all communication and electronic intelligence efforts (recommendation no. 7) but efforts in such direction are yet to happen.[6] Though a good percentage of Army's communication equipment and procedures are outdated, it is in the process of upgrading the communication network. It has an ambitious IT proliferation programme and hopes to benefit from the private industry in this field. Army is also looking for quality systems for modernisation of its battalion and unit level communications.

India has both digital and analogous systems over a variety of media communication networks. Majority of them are not interoperable, and are not suitable for a common command information and decision support system. Army Radio Engineering Network (AREN) and Army Static Communication Network (ASCON) are not compatible to Air Defence Ground Environment System (ADGES), but a process is on to integrate them. Both AREN and ASCON are being upgraded to the next generation. These networks use optical fibre systems and satellites for communications.

---

6. Kargil Review Committee Report, available at http://www.rediff.com/news/2000/feb/28kargil.htm

AREN can manage the fielding of as many as 35 different types of communication equipment including types of radios and radio-relay equipment, node and access switches, multiplexing and secrecy equipment as also systems for providing telephone communications for mobile subscribers. The AREN has been fully fielded and a Tactical Communication System finalised. ASCON, which as a backbone network, has been implemented by the local industry. The existing ASCON networks have been expanded to include all commands and areas. Plans for its future expansion have been finalised. The existing microwave links of ASCON have been replaced with optical fiber cable.

Besides the ASCON and AREN, Corps of signals have communication networks using microwave, ultra high frequency, optical fiber systems and satellite systems with security overlays duly incorporated. Of securing radio and VSAT equipment have also been inducted despite heavy odds, signalers managed to provide speedy operational and rearward communication to fighting formations in the Kargil war. The electronic warfare support, fielded in the valley, played significant role in gaining information about the enemy's plans in Kargil during the war. Meanwhile, work continues on Army Strategic Operational Information Dissemination System (ASTROIDS) and Defence Communication Network (DCN). DCN is envisioned as seamless communication architecture between the three services. The concept envisages that while each service continues to develop its own network for their specific requirement, they get integrated

at specific levels in the field, as also with MoD (Ministry of Defence) and other ministries, through the proposed DCN. Its system architecture will include nodes at strategic locations inter-linked to form a backbone network complemented by satellite network overlays and access networks, state-of-the-art transmission equipment, terminal equipment capable of providing all value added services networking management and control hierarchy at different levels. The Approximate cost of the project is about Rs 500 cr to Rs 600 crores.[7]

In the field of satellite communications, the private industry has co-operated with the armed forces, in projects with combined worth of over Rs 1,250 crores. But since defence communication with commercial satellite like Iridium or Hughes have further security problems, defence organisations should get more transponders on the Indian National Satellite (INSAT) 2 and 3 series of satellites. The third generation INSAT-3 series will provide C-band, extended C-band and Ku-Band transponders for Satcom, which could be used for defence purpose.[8] These will provide secure speech and value-added data communication to the military formations, units and sub-units deployed in counter-insurgency in northern, eastern and southern sectors. ITI Ltd. has delivered the Low Intensity Conflict Operations Very Small Aperture Terminal System (LICO-VSAT)

---

[7]. From reports on the Seminar on '*Military Communications: Role of Industry*', 10-11 August 2000 (New Delhi), available at the website of 'Chamber Of India Industries' task force on defence www.ciidefence.com

[8]. S K Tripathi, "A perspective for IT: The Army in the Information Age", *Combat Journal*, March 2000, p. 55.

offering direct connectivity of voice and data to 20 centers, including Kargil, partappur (Siachen Base Camp) and Bhuj in Gujarat. While the Department of Space has done excellent work in building up space segment capabilities, India still lags behind in indigenous capabilities in the ground segment. This makes India vulnerable in terms of dependence on foreign sources for most ground segment equipment requirements. Since optical fibre is considered the most secure and survivable for communications in a nuclear environment, Department of Telecom is planning to cover maximum location in the country with optical fibre network.

India's current communication projects could become obsolete and outdated. The need is to have reduced cycle time in development and even procurement and the overall modification of the existing system. By this, the existing voids would be filled and the need to outpace the adversaries would be served. Merely going in for commercial off-the-self technologies is not enough. Platforms for communication need to be modified with ruggedisation and re-engineering software from enhanced features.

Computers:

Towards the end of 1990s, Indian was perceived as a potential information superpower in 21st century, due to talent in information technology, minimum censorship in information and communication technologies. 'Information technology is to India what oil is to Gulf', became a standard phrase. Many governmental initiatives were taken towards this, especially

the IT task force, the group on telecom and other committees which looked into various IT-related issues. A draft New Telecom Policy 1999 was opened for discussion, which was approved by cabinet on March 1999 also, a draft Information Technology Act was put up by the Department of Electronics to the legal department, which was subsequently converted into a law.[9]

By the extraordinary gazette notification 160 of July 25, 1998 the Indian government has expressed determination to be counted as a 'Third Wave' nation by 2008. It was evident that the Indians recognised the potential of Information Technology and decided to take steps that would facilitate it to emerge as an IT superpower. The National Task Force on IT and Software Development were set up to draft a national IT policy. Prime Minister's Task Force report on Information Technology has stated that Information Technology promises to compress the time it would take from India to advance rapidly in the march of development and occupy a position of honour and pride in the comity of nations.[10] The Task Force's report in July 1998 'IT Action Plan' had 108 recommendations, including in the area of defence. IT is sought to be used as a force multiplier for defence. There is realization that introduction of RMA features to Indian armed forces requires development of IT capabilities at the national level. The Indian

---

[9]. Prashant Bakshi, "Security Implications for a Wired India: Challenges Ahead", *Strategic Analysis* (New Delhi), Vol. XXV no 1, April 2001, p. 105.

[10]. n.1, p. 1453.

Armed forces need to develop its own goals and vision for IT management perspective in the 21st century.

The Army seems to have come a long way in setting up for itself certain targets for an IT roadmap. The Army has formalised its vision in an IT Roadmap-2008'. In consonance with the national policy, around two to three percent of the budget has been earmarked for IT and a large number of 'automation projects' have been undertaken, for which the army had signed agreements with the private industry. The Army IT Roadmap-2008's vision is to establish a strong IT infrastructure to act as a viable force multiplier by incorporating fully automated and networked operation information system and management information system, complemented by a fully IT literate manpower. The vision document discussed creation of databases at all levels to provide information for quick decision–making by commanders at all levels for Administrative as well as operational functions.[11]

The Army is developing IT-related technologies indigenously to cut costs and reduce dependence on field exercises and training that involve expensive equipment.[12] An extensive computerisation programme is being carried out in a phased manner. The DRDO developed PC-based war-games to train officers, called *Shatranj* it is software to train men at the

[11]. Action Taken Report of The National Task Force on Information Technology and Software Development (New Delhi), Ministry of Information Technology, Government of India, also available at www.mit.gov.in/atrnt.htm

[12]. R. Prasannan, "War Games", *The Week* (New Delhi), March 1998, p. 34.

battalion level, commissioned in 1998. *Sangram*, another software, is being installed at Army training command. Army has also taken up the project to build an Intranet, interconnecting all its establishments and camps. The Army Intranet needs to be extra-secure, must have enhanced survivability and must be using operating systems.

The Army has taken the help of private industry in suggesting methodologies and packages to train the manpower in use and management of an IT-rich environment. Already, an Army Institute of Information Technology (AIIT) has been established at Hyderabad. The Military Intelligence School and Depot in Pune has a Digital Imagery Analysis Center (DIAC). It has the latest technology for training in satellite image analysis and interpretation.

Intelligence set-up:

In the nineties, the intelligence system, with each service having its own intelligence directorate was seen as inhibiting the exploitation of all available resources. It was not suitable for co-ordinate tasking of intelligence resources, often resulting in duplication of effort with each service doing its separate country and area studies and analyses. It impeded flow of information and analysed data between defence and civil agencies, due to attitudinal barriers, information hoarding, insufficient knowledge of the function of other intelligence organisations, procedural delays and obsolescent methods of exchanging information. The result was lack of

centralised prioritisation and rationalisation of intelligence thrust areas and action plans.[13]

The joint intelligence committee (JIC) co-ordinates the National Intelligence Organisation and prepares status papers and strategic applications. But in late 90s, Joint Chiefs of Staff Committee proposed Defence Intelligence Agency (DIA), to overcome the near-total absence of actionable intelligence. A common DIA would solve a number of maladies of our present intelligence system. The Kargil Review Committee also recommended an integrated DIA. In fact, Prime Minister V P Singh granted the secret authorisation of DIA as early as 1990-91. But nothing much was done on this in the rest of the decade.[14]

Many of the hostile groups operating within the country benefit from the expertise of foreign intelligence services and are able to latch on to frequencies, and can also demodulate radio frequency transmissions that have been modulated and demodulated after transmission. Almost all messages now need to be encrypted and online encryption is of immediate necessity. Therefore, above anyone else, it was the intelligence community that received a rude shock in the aftermath of Kargil conflict, in which it was caught napping while the terrorists infiltrated from across the border,

---

[13]. n. 6, Recommendation no. 7.

[14]. Praveen Swami, "A New Intelligence Organisation", *Frontline* (Chennai), March 2002, pp. 124-125.

with tacit support from the Pakistani regulars and its intelligence establishment. Inadequate co-ordination at the ground level among army intelligence and other agencies was later widely criticised. This was lacking even at the Joint Intelligence Committee (JIC) because of the low level of representation by Director General of Military Intelligence (DGMI) at the assessment process and the DGMI representative not coming fully briefed on the latest situation.

India's external intelligence agency Research and Analysis Wing (RAW) facility in the Kargil area, primarily responsible for collecting information on adversary's military deployment, did not receive enough attention in staff and technological capability, weakening intelligence collection, co-ordination and follow-up. In most advanced countries, the armed forces have a defence intelligence agency with a significant collection capability, which ensures that there are two streams of intelligence, which enable governments to check one against the other. But in India, threat assessment at largely a single-track process dominated by RAW.

India intelligence structure is flawed since, there is little backup or redundancy to rectify failures and shortcomings in intelligence collection and reporting that goes to build up the external threat perception by RAW. It. is neither healthy, nor prudent to endow that one agency alone with multifarious capabilities for human, communication, imagery and electronic intelligence. Such process of intelligence gathering and reporting

lead to an overload of background and unconfirmed information and inadequately assessed intelligence that required being further pursued.

There is no institutionalised process where RAW, IB, BSF and Army intelligence officials interact periodically at levels below the Joint Intelligence Committee. The army never shared its intelligence with the other agencies or with the JIC. There was no system or Army authorities at different levels from DGMI downward to provide feedback to the agencies. The general lack of awareness on the critical importance of the need for assessed intelligence at all levels is lacking.

The assessment process had been so downgraded that various agencies send very junior officials to JIC meetings. The DGMI did not send any regular input to the JIC for two years preceding the Kargil crisis. The post of chairman of JIC was left vacant for 18 months until December 1998. There was no system of regular periodic and comprehensive intelligence briefings at the political level and to the committee of secretaries. It is imperative to have an institutionalised mechanism for co-ordination or objective-oriented interaction between intelligence agencies and consumers at different levels. A mechanism for tasking the agencies, monitoring their performance and reviewing their records to evaluate their quality is lacking nor is there any oversight of the overall functioning of the agencies.

Therefore, the Kargil Review Committee stressed a thorough examination of the working of the intelligence system with a view to removing these deficiencies. Through the efficacy of the JIC has increased since it became part of the National Security Council Secretariat, its role and place in the national intelligence framework should be evaluated in the context of the over-all reform of the system.[15]

Meanwhile, Intelligence Bureau (IB) officers reportedly complain about lack of technical experts. The technical cadre is simply unable to cope with the new challenges before them. The organisation has not even been able to set up a basic in-house database system. It has reportedly prevented internet connection for staff offices for penetration. Though IB has a function communication and telephone interception capability, the organisational culture and its rigid hierarchy will have to be removed to make best use of the new technological advances.[16]

Saxena report had suggested that IB should be given a charter, of which there is still not much movement. The report also recommended that the IB director should be freed from having to report to the Home Secretary, so that Ministry of Home Affairs stops treating IB as just an appendage or subsidiary unit. But as of now, the IB director does not enjoy any authority

---

[15]. n. 6, Recommendations 9, 10, 11.

[16]. Ibid.

to compel his ministry to take the kind of action necessary for upgrading the state police forces, which the Saxena report had suggested.

Surveillance and Reconnaissance:

Knowing one's enemy well in advance is key to an information-oriented warfare. For this, capabilities to see deep into the enemy territory and understand its troop movements will have to be developed. A variety of technologies have been perfected in recent years for this purpose. They are sensors and surveillance devices, which operate from the ground, from the air as also from outer space. From ground, the devices include ground sensors, radars, border monitoring devices, night vision equipment, and thermal imaging systems. From the air, there are Unmanned Aerial Vehicles (UAVs) also called Remotely Piloted Vehicles (RPVs), and surveillance and reconnaissance planes. From space, the satellites with remote sensing capabilities can be used for military purposes, to look deep into enemy territory. In all these areas, India has some amount of capabilities, but not extremely secure or satisfactory. The capabilities in space technology are yet to be fully utilised for military purposes. But the potential in these areas is definitely impressive.

The Kargil war exposed the absence of proper technological monitoring of the borders. The army and other security forces have lagged behind in the quality of their surveillance equipment although technologically superior equipment was readily available in the world. Only after the Kargil

intrusion was direction-finding equipment acquired. Helicopters employed for air surveillance patrolling did not have sophisticated monitoring and sensing devices. The Kargil battle was fought with less than optimum communications, surveillance and reconnaissance capability. While self-reliance and indegenisation are sound principles, the availability of critical equipment in time of combat is the supreme consideration that must govern acquisition policy.

While Kargil highlighted the gross inadequacies in the nation's surveillance capability, particularly in satellite imagery, steps have been initiated to acquire this capacity. Some Unmanned Aerial Vehicles (UAVs) have been inducted by the armed forces and are operating in the plains under the charge of the army. High altitude UAVs need to be acquired in large numbers, as they could prove effective in counter-insurgency operations, and may replace human patrols in the long run. Employing UAV is extremely important, as they would enable aerial monitoring of the LoC without putting aircraft and aircrew at risk, a classic replacement of the man with machine. But acquisition of high altitude UAVs has to be complimented by institutionalised arrangements to ensure that imagery generated by them is disseminated to concern intelligence agencies as quickly as possible.[17] Army has acquired Israeli searcher MK II UAV. It can fly upto 12 hours deep into enemy territory and provide real time or continuous target data. The indigenous Nishant UAV is also around.

[17]. n. 6, Recommendations 4, 5.

DRDO also has developed some remotely piloted vehicles. They fly at a slow pace and spy on enemy, sending down picture and data in real time. Even if heat-seeking missiles shoot them at, they can be de-throttled from the ground. They have a larger radar profile and are cheap, therefore dispensable.[18]

A satellite imagery capability of work standard has to be developed indigenously and put in place in the shortest possible time. Instead of creating a surveillance system for the armed forces alone, it would be wise to source satellite imagery from the already existing strong line of civil-purpose satellites.

Indian Space Research Organisation (ISRO) has a significant civil remote-sensing satellite capability, which can be tapped for military surveillance and reconnaissance also. ISRO's satellite programme, originally meant to help India plan how to utilise its natural resource, have now 20 percent of the global market for commercial satellite imagery. ISRO has five remote-sensing satellites (Indian Remote sensing satellites or IRS) and the sixth one with one-meter resolution is planned to cater to defence purposes alone, the second such satellite in space. In its continuous process of modernisation, advanced sensors have been put on these satellites, to peer through even snow-capped areas. These cameras in the satellites can view objects on the earth from an 800 kms orbit. ISRO now plans to have

[18]. n. 13, p. 36.

satellites with more advanced sensors and at least one satellite with a 2.6-meter resolution, basically used by spy satellites, which would help the defence segment.[19]

In the Triumph-98 exercises, the picture sent by ITS-1C at pan 91-53 B were taken from a height of 850 kms and showed every sand dune and tank navigable paths across the Thar Desert. In the army, the task of locating enemy guns and mortars is with the Surveillance and Target Acquisition Branch (SATA), which have Stentor long-range Battlefield Surveillance Radars (BFSRs) and Cymbeline mortar locating radars. Satellites such as the French SPOT, the Russian KRV-1000, the Indian IRS-C and the Canadian RADARSAT could be purchased by India at relatively lower prices.[20]

Satellites surmount line of sight limitations and extend the range of voice and data transmissions crucial to a fast and responsive command and control system. Surveillance satellites provide inputs to be acted upon by agencies including surface and aerial weapon platforms. In the long run, India cannot rely solely on commercial satellites, whether Indian or foreign. It will have to develop high-resolution military satellites for monitoring its disputed borders.

---

[19]. B. R Srikanth, "Satellite Imaging: Long Site", *Outlook* (New Delhi), 14 January 2002, p. 147.

[20]. n. 13, p. 37.

Aerial sensing methods could employ photographic and video cameras, both visual and infrared sampling instruments and radars. The IAF already has well-established capabilities in aerial sensing, which include a squadron of MIG 25 aircraft employed in the strategic reconnaissance role, an electronic intelligence unit comprising Boeing 737 aircraft, and a proven photographic interpretation expertise. The IAF has reconnaissance flight, which can use Long-Look Optical Systems (LLOS), Infrared Line Scan (IRLS) and Synthetic Aperture Radars (SAR). Aviation Research Center of the RAW has its own specialized capabilities in this field. Further investments into these vital capabilities are essential.

Regular Air Force and Army aviation reconnaissance sorties need to be flown to detect intrusions. The IAF should acquire additional surveillance assets, where necessary and feed its inputs to a national level intelligence collection, compilation, analysis, synthesis and dissemination center. This, combined with human intelligence, (humint) will enable a comprehensive border surveillance and intelligence acquisition plan.

Kargil has highlighted the vital need to monitor the borders. Technical monitoring of the LoC through both, on-site and remote sensing could prevent another Kargil and avoid a Siachen. Ground sensors would be another category of technical verification measure, which would include seismic, acoustic, magnetic, infrared, thermal and radar devices. Ground

surveillance means also include Battlefield Surveillance Radars (BFSRs) and Un-attended Ground Sensors (UGS) in remote areas.[21]

Such sensors could be used to monitor the movement of troops or equipment along access routes to deployment areas and to detect the provision of aerial supplies in order to forward positions or to monitor base camps away from the Line of Control. India has acquired and begun license-production of France's Stentor battlefield surveillance radars. It can track movement of vehicles and troops at ranges of 20-31 kms. There were discussions in the late 1990s for Israeli Elta ELM-2140 battlefield surveillance radar. Army has also procured a range of close observation night vision devices and thermal imaging systems. India will also have to place optical, video, motion and thermal sensors in the camps and posts vacated during the winter. Radar, seismic and acoustic sensors would have to be employed to verify Pakistani air activity. Multi-spectral optical, infrared and radar photography capability are necessary for effective surveillance by day and night. Electronic surveillance means also provide an excellent means to gain information about the plans and movement of regular enemy troops, irregulars and terrorists. All these capabilities are yet to be fully explored.

---

[21] . Varun Sahni, "Preventing Another Kargil, Preventing Another Siachen", in Kanti Bajpai (eds) *Kargil and After: Challenges for Indian Policy*, Har Anand (New Delhi), 2001, p. 147.

This is not to suggest that the machine can replace man. After all, it is the human agency and ingenuity that would design, produce, test, deploy and replace the sensing devices. Human beings would interpret the data from both on-site and remote sensing devices. The machines would not replace man, but would replace the man on the Line.[22] Therefore appropriate force structures and procedures should be evolved for managing the borders, to deal with inflow of narcotics, illegal migrants, terrorists and light arms proliferation.[23]

There is bound to be distrust in technical monitoring at first. But with the passage of time the Indian Army would begin to again confidence in, rely on and trust the sensing devices. Once both sides reach the border deal, the unilateral technical monitoring might be replaced by co-operative technical monitoring.

Information Warfare capabilities:

Traditional military information security has revolved around the concept of specialisation facilities to encryption and decryption of messages. During transit and storage, data is open to various security threats. Traditionally, Indian defence forces to safeguard the access to data and data integrity had used manual cryption systems. But traditional methods fail to meet the current speed and quantity needs. This makes the information

---

[22]. Ibid, p. 156.

[23]. n. 6, Recommendation no. 14.

security issues more complex. In modern times, widespread deployment of computers and computer networking has created vulnerabilities that did not exist before. Adequate attention had not been paid in India to develop encryption and decryption skills.

Advanced software techniques have now been introduced for cryptography and cryptanalysts. With increasing parity among conventional elements of warfare, the difference between the victor and the vanquished often shall be in effective, rapid deployment of information across networks and chains of commands, stretching up to the individual on the battlefront.[24] Very few Indian establishments are seen to be using encryption technologies regularly. While the intelligence Bureau and the RAW have secured some key voice and fax lines, many communications, including satellite telephones remain unencrypted.[25] The DRDO and the CVC (Central Vigilance commission) have sounded red alert on the purchase of security-related software, especially data encryption systems, because these software can be broken by the US national security agency. This makes it imperative for India to develop its own security software.[26] The armed forces have recommended to the government (IT Task Force Recommendation-104) that defence cryptographic systems be made available to the civilian sector to enable electronic fund transfers and digital

---

[24]. Akshay Joshi, "Information Technology and Security an Update", *Strategic Analysis* (New Delhi), Vol. XXIII no 2, May 1999, p. 255.

[25]. Praveen Swami, "The Surveillance Scene", *Frontline* (Chennai), 13 April 2001, pp. 134 -135.

[26]. Ibid.

signatures. India can make cryptographic algorithms, which will be difficult to crack.

It was observed that irrespective of its strengths in information technology, India could be severely battered if an enemy country launches a concerted cyber-offensive. Doubts are often raised as to whether India is prepared to wage a war in the bloodless war-zone called *cyberspace*. Many a ministry's websites, including that of the Ministry of External Affairs and Defence Ministry have been hacked by pro-Pakistani web-warriors. India and Pakistan have been fighting a war over information, with several Interest recourses hacked in both countries. With some of the best software manpower in the world, the fighting becomes even more ferocious. Several top Indian and Pakistani computers professionals are helping their respective governments by supplying information as the best way to harm the enemy's defence systems.

The Indian defence establishment was given a rude shock when amateur hackers broke into the web sites of Bhaba atomic center and Indian Army. In the Bhaba hacking incident, a group of Australian and American teenagers opened the email system of the Atomic Center, soon after the Shakti test. BARC's internal network password was hacked and since the server of the army website (*armyinkashmir.com*) was not located in India, it

was easy to crack.[27] The Pakistani hackers posing as Indians rang-up the controllers of the web site and asked them to change the IP address.

The Indian government traced this hacking of a Pakistan-based information services firm. The hackers had managed to divert all logins to the Indian site to their own in Pakistan for two days. During Kargil also, the site *www.armyinkashmir.org* was attacked with about 200 e-mails of support and financial help being received daily by the Indian government at this web address, as the mail component of the website was tampered with. All pro-Indian e-mails were diverted to a different address. The Indian armed forces however used some best computer professionals in the country and recovered the site from the hack attack.[28]

The Indian government, on its part had cut off all network access to Pakistan's prominent newspaper, The Dawn in 1999 for a fortnight, but restored it after opposition wide spread domestic. Most of the government sites on both sides of the border have been attacked.

The high profile and sensitive websites hacked into, include that of Department of Atomic Energy, Indian Institute of Science, Ministry of External Affairs, Department of Telecom, and University Grants Commission. Pakistani hackers with odd names like GFORCE Pakistani,

---

[27]. "Information Warfare: Is India Prepared for it ?" *Times of India* (New Delhi), 14 may 2001, p. 6.

[28]. B. Raman, "Proxy Wear in Cyber Space", *Indian Defence Review* (New Delhi), Vol. 15(4) October-December 2000, p. 138.

Muslim online Syndicate, Silver Lords, Kill India, and Dr Nuker have managed over 260 events of defacing Indian websites. The Pakistani propaganda websites like *roguearmyout.com* wage a symbolic battle against India on the cyberspace. Their activities also include directing unwitting Internet surfers to anti-India websites and circulating instructions on how to break into Indian websites. At least 365 websites had been hacked into, which include commercial ones. Though the other hackings can be considered as of nuisance value, the breaking into commercial sites can cause economic damage. Also sensitive hacks like BARC and Indira Gandhi Center for Atomic Research can endanger national security. Recently, it was noticed that some Chinese groups have also hacked into some Indian websites. One such group cracked open the public-sector unit CMC LTD's site and flooded it with anti-US slogans, ostensibly because India's open support of American proposal of Nuclear Missile Defence System.[29]

India is a very soft target for cyberwar attack, as many companies and government sites do not care much for computer related and network security. Web hosts are more concerned about getting their sites online than about security issues. As a result, roughly Pakistani hackers deface two Indian websites each month. Not even a single hacker has been caught or punished, as tracking them is extremely difficult. The Information Technology Act had declared hacking an offence, irrespective of its

---

[29]. Malini Goyal, "It's War", *India Today* (New Delhi), 18 June 2001, p. 52.

objective, punishable by Rs 1 crore, making it impossible for Indians to respond in the same coin. However, India has practiced some propaganda war in the hacking of websites of the Pakistani government and that of the terrorist outfit Lashkar-e-Toiba. The Indian army now has an Internet cell which takes help from highly skilled computer professionals. The basic function of these web-warriors is to defend Indian military installations from hackers.

As Information Technology becomes synonymous to social, economic and military survival, the armed forces are being compelled to create a Defence Information infrastructure (DII) to meet the emerging threats and vulnerabilities of the cyberspace. Creation of DII and the electronic security infrastructure is essential for the higher management of the armed forces. Presentations have been made to the armed forces on DII as a 'system-of-systems', consisting of a set of network-centric applications and comprehensive e-security overlays. For this, the defence forces would need consortium level partnerships with the industry. Ideally, the DII should have encryption, identification, authentication, access control devices, and intrusion detection systems, network surveillance etc. Armed forces can also make use of professional services like vulnerability assessment, security planning, design and integration of e-security overlay, contingency planning, disaster management and post deployment support.

Information Warfare

The entire system discussed above and its success depends on information collection, its processing and application. Information technology is the Key for modernisation and growth towards self-reliance and wage war in infosphere. On the other hand, it has opened up the much-dreaded Pandora's box. Such type of warfare can disrupt military command and control system and course serious economic damages. It may be understood that an interjection in the loop described in the diagram, could have serious repercussions. India is yet to attain such status similar to the advance nations, but is gradually creeping towards that eventuality where sensor to shooter loops is getting tighter and vulnerability to hacker attacks becoming a reality.

Indian military must understand its importance, and take this into account with its relevance for RMA of this century. Key technologies to make a thrust in this field will be possible by a right mix and integration and knowledge in a meaningful time frame. Technologies those could used be effectively are:

- Communications and networking
- Automated fusion of imageries Automated target recognition
- Satellite technology for communication, communication intelligence, electronic intelligence
- Global positioning system (GPS) and mapping
- Sensors:

» High efficiency radio frequency source

» High-energy lasers

There are certain special global characteristics of the Information Warfare. These are:

No International Borders: Like other forms of attack, Information related attacks could carried out from anywhere in the world which do not respect the nationality or national boundaries. There are no ways to know who is under attack and who is attacking, and what is the difference between trans-national crime and warfare.[30]

Low Cost Warfare: Adversaries can acquire the necessary equipment to wage this type of warfare at a very low cost. They would require a few computers and good connectivity to attack any network or steal information from them. Even if the entry is restricted to network determined attacker will find a way to intrude and do the necessary damage. But the question arises, whether such an intrusion could change the course of the future battle.[31]

Information a Tool of Subversion: Use of Internet to build up political support or work in the psychological factor of nation has been spoken about most glibly t the advance nations. But in a country like India, it would not have such catastrophic effect as has been portrayed by the strategists.

---

[30] . Martin C Libcki, *What is Information Warfare?* National Defense University Press, (Washington D C), 1995, p. 60.

[31] . Ibid.

Jammu and Kashmir Liberation Front (JKLF) and many others. Terrorist's organisations have been maintaining immaculate websites for a long time, which has not created the expected psychological impact either nationally or internationally.[32]

Tactical Warning and Attack Assessment: Nature of threat is rapidly changing and the targets are also not as clearly defined as it used to be. As a result, traditional methods of intelligence gathering and analysis would be taking a back seat in the face of the challenges thrown up by the IW environment.[33]

A limitation of information warfare has to be reviewed at a different plane in the Indian context, despite the doomsday effect forecast by its proponents. The experts in this field are not convinced about its invincibility or its ability to disrupt or defeat a country soundly to conquer a nation. Prof Libcki pointed out that " In its ability to bring a country to its knees, hacker warfare is a pale shadow of economic warfare, itself of limited value. Suppose that hackers could shut down all phone service nationwide for a week. The event would be disruptive certainly and costly (more so every year), but probably less disruptive than certain natural events, such as snow, flood, fire, or earthquake – indeed, far less so in terms of lost output than a modest size recession." [34] This may be fairly

---

[32] . Ibid, pp. 60-61.

[33] . Ibid.

[34] . Ibid, p. 64.

optimistic but it can be stated definitely that information warfare couldn't be as destructive as other weapons of mass destruction.

Chapter Five: Conclusion

In the 1990's, India faced threats primarily emerging from the insurgencies and cross-border terrorism and the need to protect the borders, which remain largely unresolved. The military modernisation programme of the Chinese armed forces and its supply of arms to Pakistan continue to pose threats to India's security, which India would have to take into consideration when modernising its forces. Pakistan meanwhile continues fuel a proxy-war through cross-border terrorism and developed a strong military industrial complex and continued to modernise its forces, largely through purchase of military hardware from foreign sources. There is a long-term indirect threat from the presence of US and its direct or indirect supply of arms to several conflict ridden regions. The need to protect India's energy assets and information networks and check the proliferation of small weapons and narcotics have often been more visible areas of concerns. Monitoring the borders and the sea remain crucial in preserving India's territorial integrity and in protecting its interests and resources.

But the problem does not lie in the military hardware alone. How the available technology is to be used in organising the armed forces towards achieving national objectives remains other most critical area to ensure that most effective solutions are found by the innovative application of technologies. India has a large military and changes in modernisation will

require large-scale application. This can delay the reach of military innovations to all parts of the armed forces. Threats of adequately and less expansive manage trough a manpower intensive force than through high technology. A capital-intensive military, with a nuclear capability and relative absence of multiple external threats suggests that the current structure is adequate.

The process of Indian armed forces modernisation faces a virtual standstill after the collapse of its main military supplier, the Soviet Union. The shock was compounded by the humiliating defeat faced by the Indian peace keeping forces in Sri Lanka, who returned in 1990. This was also the time when RMA debate had globally begun to arise following the first Persian gulf war of 1991. Since then, modernisation has not been steady or top priority to fragile governments that ruled the ten years under review. But things began to show changes towards the end of the decade.

The BJP-led government successfully carried out nuclear tests and embarked on a programme of modernisation. But much of this modernisation was again based on purchase, local upgrades than innovations at home. At the end of the decade, a conflict with Pakistan has thrown open chinks in the armour for the world's fourth largest army. The Kargil war highlighted the rationale of limited war, a result of economic and political consideration as also fear of nuclear flare-up, high casualties and international pressure, low intensity or limited warfare is characterised

by limitation on its conduct and space: limited in time, geographical area and force level. Concepts of RMA have to occur within the constraints and doctrines of limited war. The Kargil war showed that if the threats remain what they are, with the current force levels and equipment, India is capable of acting effectively, as it did in Kargil, which also showed India's potential in co-ordinating air power and ground forces.

An analysis of the three services of Indian armed forces leads to the conclusion that there is a need to reduce manpower, and increase lethality of forces. This could be done by reorganising mechanised forces, combat arms and supporting services on task-specific lines, reducing mount divisions and progressive suppression of field forces and it is possible to reduce up to 200,000 personnel over a decade. The army's initiative to end field force of 50,000 people to make available Rs 600 crore for modernisation could be applied by other services also. Given the importance of counter-insurgency operations in security, armed forces have to be trained in dealing with an asymmetric threat.

Meanwhile it was noted that raising a force specially trained force for counter-insurgency operations, which could also provide rear area security during war is needed, can gradually help army to go back of its primary function of guarding the nation's borders and preserving its sovereignty. Counter-insurgency assignments should perhaps soon go back to police and

paramilitary organisations. This is something that Indian armed forces have insisted for years.

II

Information technology penetration of the armed forces is essential in optimising the emerging technologies and applications in dealing with future threats to security. While Indian armed forces are emphasising computer literacy, it is having difficulties in recruiting, training, promoting, and retaining such technicians with RMA related skills. Army has an Information Technology vision statement, Air force has an Air Power Doctrine and the Navy has a similar plan for the future, all of which have pledged to incorporate the fallout of the new RMA. Which is seen today as an inevitable reality.

On a doctrinal and organisational level, a Strategic Defence Review, National Security Council (NSC) and the organisation of the Chief of Defence Staff (CDS) are yet to take full shape. Though in place, the NSC is yet to become integral in the decision-making process. There has been criticism that NSC is a group of people drawn from different walks of life-soldiers, academics, journalist, bureaucrats, and politicians-with different ideas on what constitutes security threats and to deal with them. The role it played in decision-making is minimal. Mostly the Cabinet Committee on Security (CCS) has been taking decisions on critical times. On the issues of CDS, there was much debate, as it was hailed as need for a nuclear nation to have proper command and control mechanism.

Interservices rivalries have plagued the implementing of the CDS, which led the government to put it in cold storage for the time being. There is no strategic doctrine that spells out India's security threats, military goals and imperatives and the role it wants to play in the region in particular and in the world in general. The absence of a strategic doctrine has led to lack of proper strategic thinking and advanced planning. Tri-services doctrines will have to be evolved to specific security environment so that our operational plans can be designed.

Intelligence establishment needs improvements in tune with the requirements and the technological innovations in the field of information collection, dissemination and distribution. There is need to acquire more reconnaissance and surveillance equipment including aerial reconnaissance vehicles and ground sensor as well as geo-positioning systems. In analysing the inventory modernisation of all three services, it was concluded that there was no pursuit of revolutionary increases. A Perception remains that there is no predictable threat that India cannot match with its planned acquisitions and force posture. Innovative technological solutions are considered expensive, not perceives as necessary, and against the grain of existing bureaucratic and organisational preferences. There is no vision of military reform, much less revolution. All three services give emphasis on overhauling and improving existing platforms and buying spares for local

upgrades rather than spending money and time on research and development. But often the purchase of systems from abroad leads to maintenance problems. It has been seen that the purchases are often made for outdated and worn out weapons and platforms. The technology becomes obsolete before it is completely incorporated into the armed forces. This further necessitates more purchases.

Meanwhile, local production has suffered immensely because of lack of funds, and delays, labour issues as also assembly problems. The examples are Arjun Main Battle Tank, Light Combat Aircraft, Pinaka multi-barrel rocket launcher system. India's Integrated Guided Missile Development Programme also suffered major delay because of technology control regimes and fund troubles. Much of India's shipbuilding also suffered for the same reason. Though Navy has been able to incorporate foreign designs in local manufacturing procedures. The Air Force largely remains a 'Buyer Service' with almost all its inventory–platforms and weapons coming from abroad. A large number of air force fleet are of Russian origin and much of it has expired their use, but are still in service. This contributed to high accident rates. Local overhaul of MiG fighter aircraft remains a problem, due to lack of availability of spare parts and assembly problems. An Advanced Jet Trainer could not be developed locally, and decisions are yet to be made on buying it from aboard.

III

New defence relations with Israel and US will be significant, as India needs to diversify its arms market and escape form the various technology control regimes. This has been necessitated by the fatigue and lack of readiness faces by India armed forces for the larger apart of 1990's due to the absence of key military supplier and the draining of spare-part markets. For India, the ratio of high technology assets to ordinary delivery platforms would remain low for years. Stretching the operational life cycle of existing weapon systems through mid-life upgrade provides incremental modernisation at far lower and affordable cost. The complacency due to license production has affected the development of design and production capabilities.

The Rs 4,112-crore military equipment market that has been thrown open to private companies is not huge. But it is growing. Estimate suggests, the market could balloon to Rs 10,000 crore in another five years. [1] India's current defence procurement of Rs 34,707 crore, 70 percent is imports. Out of the remaining 30 percent, a sizeable chunk goes to the PSUs, leaving a minuscule amount of Rs 4,112 crore to the private players. But the government's policy change has signaled opportunities Indian businesses are upbeat about that indeed the Ministry of Defence estimated that the rules of the game could get reversed by 2020 when 70 percent of defence

[1] . R.K. Jasbir Singh, *India Defence Yearbook – 2004*, Natraj Publishers (Dehradun), 2004, pp. 570-571.

equipment could be made indigenously and 30 percent procured form outside. The MoD awarded licensees, in March 2003, to two private companies out of 10, which applied to design and manufacture a range of military equipment as part of its long-standing bid to privatise its monopolistic, state-owned defence industry. [2] Later, as many as 13 letters of intent were given to private companies for production of defense equipment, the Union Minister of State fort Defence, O. Rajagopal, said on 16 October 2003.[3]

India is no doubt an industrial power. Its industrial base has spread indifferent spectrum and it would be advisable for the military to reduce foreign dependence as much as possible and exploit Revolution in military Affairs (RMA) in order to improve upon the ability to perform the future tasks effectively. Modernisation of older systems and incorporate present generation technology with an eye to incorporate the futuristic developments, Self-reliance and indigenisation for the military equipment is extremely important because high level of military technology would be very costly to import and sustain in future.

Any medium-term plan of modernisation of armed forces may involve an additional burden of Rs 3,000 crore of Rs 4,000 crore. If GDP growth is sustained at 6 percent to 7 percent, this order of expenditure can be

---

[2] . Ibid, p. 571.

[3]. Ibid.

sustained without serious impact on fiscal management. More than increasing the share of defence expenditure in national income, India's priority should be to restructure such spending towards modernisation of the armed forces and their infrastructure support services. Recently Indian Army has drawn up a blueprint for modernising the services in what will be the largest procurement effort in decades. The modernisation blueprint also envisions a complete overhaul of existing weaponry. The Indian Army in the next 10 years wants to buy:

- New advance command, control, communication, computer, intelligence, surveillance and reconnaissance equipment, and information warfare systems, as well as upgrades to existing systems.
- Nuclear, biological and chemical equipment, such as protective gear, detection and alarm systems, modulators, vaccine agents, bio-agents and radio protectors.
- Agni, Reflex and Kornet surface-to-surface missiles an Igla surface-to-surface missile, and fir defence system upgrades.
- Equipment to upgrade the night-vision capabilities.
- Unmanned aerial vehicles and aerostats.
- Various versions of 155mm guns, rocket launchers and other weaponry. [4]

Despite living in an intense nuclear neighbourhood, Indian would be facing both low and high intensity conflict situations in the century. The presently acquired nuclear status of India wouldn't be of much help towards RMA as it stands today. No doubt, there have been some positive achievements in he field of Battlefield Damage Assessment and surveillance capability assisted by satellite imagery and induction of UAVs. A steady supply of PGMs has also been ensured, as was display during Kargil conflict, DRDO

[4] . India's Defence Modernisation, *Strategic Digest*, IDSA (New Delhi), Vol. 35 no. 4, May 2004, pp. 471-472.

has made some impressive gains in the field of defence technology. Yet it seems that the Indian military would have to work hard to integrate itself with the information driven digitised battlefield. There wouldn't be many choices left but to adapt to this ultra sensitive environment. High mobility and rapid acquisition would be the most potent parameters. The new weapon systems being developed indigenously are yet to be inducted and till such time these are made available with the military, the system cannot be integrate affectively in overall planning. Therefore it would be necessary to incorporate the new developments into the operational planning to bring about the Revolution in Indian Military Affairs, or else the Indian military would face a new type of battlefield previously unknown.

It would be pertinent to suggest here that Indian armed forces could have their own laboratories manned by dedicated scientists to develop the futuristic weapons under a dedicated military/scientific leadership. It should be understood that technology driven RMAs are brought about by weapons or systems exploiting powerful combination of technologies, combined with supporting doctrine and organisation. Input process being the technology breakthrough, and the output being the RMA. And that is why following may be the logical steps for Indian military to achieve Revolution in Military Affairs:

- Synergy with DRDO to develop the required technology for future.
- Enter into joint ventures with friendly countries for development of defence technologies.
- Take active interest in the development of EMP and Direct Energy Weapons.

- Ensure steady supply of PGMs at the time of crisis.
- Improve upon command and control structure or three services, by ensuring steady flow of data, data fusion and interpretation.
- Develop human resources to match the technological development of the future. [5]

IV

Indian national security policy demonstrates continuity with tradition rather than a new vision of military affairs. A host of issues remain to be addressed properly like and these include issues capabilities in C^4ISR (Command, Control, Computers, Communication, Intelligence, Surveillance and Reconnaissance) and force multipliers. India is in dire need of force multipliers like weapon locating radars, night vision devices for the army, surveillance aircraft for the navy, Air Borne Early Warning and Control Systems (AWACS), Unmanned Aerial Vehicles (UAV), aerial refueling for air force. India's information warfare capabilities are not very impressive, despite being a potential Information Technology superpower.

While India has started integrating new capabilities, like use and production of Unmanned Aerial Vehicles, it is unclear if it has either the inclination or requirement of significant levels of innovation. More home-built missiles on existing platforms, greater mobility, computerisation of management and training for better tri-service integration, warfighting doctrine, improved electronic warfare capabilities are issues that need to be paid attention.

---

[5] . Kapil Kak, "Revolution in Military Affairs", *Strategic Analysis* (New Delhi), Vol. XXIV no. 14, April 2000, p. 7.

Needless to say that RMA is also pushing the reinforcement of technical, organisation, and operational factors simultaneously across all fighting mediums-air, land, and sea–and certain new areas of warfare are (or have been) emerging. If an adversary also has a Weapon of Mass Destruction (WMD) capability, the stakes and the effects on strategy could substantially shift threats by radical, aggressive regimes may well force Indian military into very different kinds of strategies. New modes of combat may have to be emphasised. Mobility, indirectness, dispersed standoff, and disengaged operations may have to be included in the doctrines and exercised.

We do not have the correct tools to assess RMA. Neither do we have any good model to emulate in the Indian context. There are certain concepts of operations and military capabilities (present and future), which are not sufficient to understand such transient nature of the future war. And it is certain that the Indian military will face the wars in 21st century characterised by:

- Greater availability of information, hence greater transparency in all facets of battle.
- Duration of the war will decrease but it will be marked by higher tempo of activities than before.
- Increased accuracy, lethality and stand off capability of weapon delivery leading to enhanced reliance on mechanised assaults and missile strikes.
- Increased mobility of opposing forces, leading to fast changing operation and tactical situations. The classic sequential progression of battle graduating from units and formations to theatre commanders may no longer hold good. In other words, the battlefield would become non-linear. This would call for speedy

decision making, greater delegation of authority of freedom of action to subordinate commanders.

- Increased reach of integral firepower and surveillance resources, including space based and underwater systems, would enhance the battle space as described earlier.
- Teeth to tail ratio for the armed forces to be much tighter. [6]

Indian Military is aware of these challenges and has been trying to bridge the technological gaps. Defence Research and Development Organisation (DRDO) have made some technological advances in recent years. Especially, the sensors systems are going through radical technological changes. Electromagnetic Pulse (EMP) and Directed Energy Weapons (DEW) would be part of India's future conflicts. However, the availability of precision-guided munitions coupled with a non-responsive Command and Control system wouldn't take Indian RMA. [7]

It is evident that the nature of warfare is in a continuous state of flux. Changes are taking place in both the character and conduct of warfare. There are several factors, which have an impact on the outcome of a conflict. Jointmanship is a key battle-winning factor in any future war and conflict. Future wars would be characterised by complexity and compressed decision cycles. Thus, a high level of synergy and sysnthesisation of inter- Service plans can only be achieved by forging a joint doctrine. It will be one such process that will harmonies and unify the thinking and efforts of the three Services towards achieving a common

---

[6]. C. N Gosh, "*Future Defence Challenges*", Manas Publications (New Delhi), 2003, p. 10.

[7]. Ibid, p. 11.

military objectives. The three Services are yet to determine what organisational structures and institutions are required for promoting a joint doctrine. The other steps of proceeding towards jointmenship and evolving a common perspective would be as a consequence of the formulation of a joint doctrine.

In this age of information based warfare of the post-industrial era, a joint inter-services network and C^4I^2 systems becomes indispensable. The hi-tech weapons, sensors and other support systems would need to be exploited optimally in joint and integrated operations. And a common inter-services network, inter-connected and inter-operable C^4I^2 systems would be vital and necessary elements in achieving such joint warfighting capabilities.

The other two aspects, which are paramount in providing the cutting edge to India's defence, forces in the coming times will be intelligence and logistics. Besides integrating the intelligence apparatus of the three Services, there is a need for enhancing the intelligence, surveillance and reconnaissance capabilities of the armed force. The need for expanding the mandate of defence intelligence to include strategic intelligence has been highlighted but the Kargil Review Committee. The Revolution in Military Affairs (RMA) is also giving rise to a revolution in military logistics. Integrated procurement and focused logistics are some of the major elements in achieving defence modernisation.

Jointmanship does not mean suppressing the unique and distinctive war fighting capabilities and culture of the single Services. In fact, in thrives on such uniqueness. Even as a nation we believe in unity in diversity. We are well aware of the Canadian experiment of making all the Services wear a common uniform that failed miserably. Single Service military judgment provides a balancing factor. However, the quintessence of jointness is in achieving a bit of flexibility in single Services approach to fulfill a common military goal. Therefore, in order to be effective in dealing with India's security threats, Indian military leadership will have to evolve a comprehensive view of RMA which goes far beyond the populist view of RMA that excessively focused on frontier technologies.

SELECT BIBLIOGRAPHY

Primary sources:

"Joint Vision 2010 & 2020", Washington DC: US Government Printing Press, 1996

Japan Defence Agency, *"Defence of Japan"*, Tokyo: Japanese Defence Agency, Annual 2001

Rubinstein, *"Japan's Maritime Self Defence Forces"* Naval Forces, 1998

White Papers on Arms Control and disarmament, *"China Daily"*, November 1998

Carlo Finizio, *"Challenge of Information Revolution"*, Paper presented in Third Asian Security Conference, Towards a New Asia at Institute of Defence Studies and Analysis, Jan 2001

A. W Marshall, *"Some Thought on Military Revolutions"*, Washington DC: Office of the Secretary of Defence, Second Version, 23 August 1993

R. J Garigue, *"Information Warfare: Developing a Conceptual Framework"*, Washington DC: Decision Analysis Laboratory, Carleton University, Draft Version 2.1, 2000

"Telecom Glossary 2000", Washington D C: American National Standard for Telecommunications, 2000

Action Taken Report of *"The action Force in Information Technologies and software development"*, New Delhi: Ministry of Information Technology, Government of India, 2001

"Annual Report", New Delhi: Ministry of Defence, Government of India, 2000-2001, 2002-2003, 2003-2004

"Information Warfare", Washington D C: US Department of Defence Directive TS_3600.1,21 December 1992

"Kargil Review Committee Report", New Delhi: Government of India, 2000

Secondary sources

Books:

Afsir Karim, (ed) *The Indian Armed Forces-A basic Guide* (New Delhi), Lancer, 1995

Ashok Karim, *India's Armed Forces: 50 years of War and Peace* (New Delhi), Lancer, 1998

A. Toffler and H. Toffler, *War and Anti-War* (New York), Warner, December 1994

Bappaditya Mukherjee, *China and the RMA* (New Delhi), Har Anand, 2000

C. N Gosh, *Future Defence Challenges* (New Delhi), Manas Publications, 2003

Edward Waltz, *Information Warfare Principle of Operations*, Artech House Norwood MA (London), 1998.

F. Fukuyama, *The End of History and the Last Man* (London), Penguin Books, 1993

G. D. Bakshi, *War in the 21st Century* (New Delhi), lancer Publisher, 1997
G.P. Otyutskiy, *Apropos of the Essence Military-Technical Revolution*, VM, no.2, 1998

James Adams, *The Next World war: Computers are the Weapons & the front line is everywhere* (New York), Simon& Schuster, 1998

Jasbir Singh, *Indian Defence Yearbook-2004* (Dehradun), Natraj Publishers, 2004

Kanti Bajpai, (eds) *Kargil and After: Challenges for Indian Policy* (New Delhi), Har Anand, 2001

Marten Creveld, *Technology and War: From 2000B.C to the Present* (U.K), Brasseys, 1991

Michael O. Hanlon, *Technological change and the future of warfare* (Washington DC), Brooking institution Press, 2000

M.A. Stokes, *China's Strategic Modernisation: Implications for the United States*, Strategic Studies Institute, Carlisle Barracks, *PA:* US Army War College, 1999

Martin Libcki, *What is Information Warfare?*, (Washington D C) National Defence University Press, 1995

Michael Vickers, *The Military Revolution Debate: Readings on the Military Transformation of Early Modern Europe* (Boulder: Westview Press), 1995

S. P Baranwal, (ed) *Military Yearbook* (New Delhi), Guide Publisher, 1991

Shanker Bhaduri, *The Indian Army* (New Delhi), Lancer Publisher, 1990

Stephen P. Cohen, *India: Emerging Power* (Washington DC), Brookings Institution Press, 2001

Sandy Gorden, *India's Rise to Power in the 20th Century and Beyond* (Canberra), St Martin's, 1995

O. Goldmen and C. Eliason, *The Diffusion of Military Technology and Ideas* (California), Stanford University Press, 2003

O. Goldmen and C. Eliason, *The Diffusion of Military Technology and Ideas*, Stanford University Press (California), 2003, p. 57

Raja Menon, *Maritime strategy & continental wars* (London), Frank Cass, 1998

Raja Menon, and R. K Dhawan, *The Indian Navy* (New Delhi), Indian Naval Headquaters, 2001

Ron Matthews, *Managing the Revolution in Military Affairs* (London), Palgrave Publishers, 2001

Sham-ud-din(ed) *India and Russia: Towards Strategic Partnership* (New Delhi), Lancer, 2001

Vijay Seth, *The Flying Machines* (New Delhi), Seth Communications, 2000

William Jackson, AV *History of India* (New Delhi), Asia Education Services, 1986

Articles:

Adam L. Peneberg, "Hacking Bhaba", *Hindustan Times* (New Delhi), December 19, 2000

Ahmed S. Hasim, "The Revolution in Military Affairs outside the west", *Journal of International Affairs* (New York), Columbia University Press, Winter 1998

Akshay Joshi, "A Holistic View of the Revolution in Military Affairs", *Strategic Analysis* (New Delhi), Vol. XXII no. 11, February 1999

Akshay Joshi, "Information Technology and Security an Update", *Strategic Analysis* (New Delhi), Vol. XXIII no. 2, May 1999

Ajay Singh, "The Revolution in Military Affairs 4-Dimensional Warfare", *Strategic Analysis* (New Delhi), Vol. XXII no.2, May 1998

Bruce Sterling, "Short History of the Internet Cornwall", *The Magazine of Fantasy and Science Fiction*, CT, February 1993

B. Raman, "Proxy Wear in Cyber Space", *Indian Defence Review* (New Delhi), Vol. 15(4) October-December 2000

B. Chandra Khanduri, "Revolution in Military Affairs: India Still Decades off", *Indian Defence Review* (New Delhi), January-March 2001

B. Raman, "Proxy War in Cyber Space", *Indian Defence Review* (New Delhi), Vol. 15(4) October-December 2000

Brian Cloughley, "Japan Ponders Power Projection," *International Defense Review* (Tokyo), July 1, 1999

CN Ghosh, "Satellites and space Application", *Indian Defence Review* (New Delhi), vol. 16 (2) April-June 2001

CN Ghosh, "EMP Weapons", *Strategic Analysis* (New Delhi), Vol. XXIV no. 7, October 2000

CN Ghosh, "Directed Energy Weapons", *Strategic Analysis*, (New Delhi), Vol. XXIV no. 11, February 2001

Dan Goure, "Coping with Chaos: The Changing Face of Modern Warfare", *Jane's Defence weekly* (New York), Vol.35 no.3, January 17, 2001

Harinder Baweja, "Defenceless Delays", *India Today* (New Delhi), May 7, 2001

Henley and B. Gill, "China and the Revolution in Military Affairs", *Strategic Studies Institute* (Carlisle Barracks, PA) US Army War College, 1996

John Cherian, "A Thrust to Sea Power", *Frontline* (Chennai), May 12, 2000

John Cherian, "The Arms Bazaar", *Frontline* (Chennai), April 26, 2002

Jonathan Marcus, "India-Pakistan: Military Balance", *BBC* (London), December 31, 2001

Janaki Bahadur Kremmer, "In the Tower of Babel", *Outlook* (New Delhi), 1 February 1999

Kapil Kak, "India's Conventional Defence: problems and prospects", *Strategic Analysis*, (New Delhi), Vol. XXII, no. 11, February 1999

Kapil Kak "Management of India's Security and Higher Defence", *Strategic Analysis* (New Delhi), Vol. XXII no. 3, June 1998

Maline Goyal, "It's WWWar", *India Today* (New Delhi), June 18-2001

M.V Rappai, "China's Military Modernisation: Some Perspective", *Strategic Analysis* (New Delhi), Vol. XXI no.10, January 1998

Mritynjoy Mazumdar, "Navy's Procurement and Modernisation Programmes", *Bharat Rakshak Monitor* (New Delhi), Vol. 3(1) July-August 2000

Nancy Jetly, "India's Security Challenges: Perspectives and Prospects", *Strategic Analysis* (New Delhi), Vol. XXII no.4, December 1997

Nicholas Berry, "Revolution in Military Affairs (RMA) Is Not Only about High-Tech Weapons", *Asia forum* (Washington D.C) Center for Defence Information: Massachusetts Avenue

Prasannan, "Indian Armed Forces Unfit to Fight", *The Week* (New Delhi), August 1991

Praveen Swami, "A Hawkish Line on China", *Frontline* (Chennai), February 16, 2001

Praveen Swami, "A New intelligence Oranisation", *Frontline* (Chennai), March 16, 2002

Praveen Swami, "The Surveillance Scene", *Frontline* (Chennai), April 13, 2001

Prashant Bakshi, "Security Implications for a Wired India: Challenges Ahead", *Strategic Analysis* (New Delhi), Vol. XXV no.1, April 2001

Prashant Bakshi, "Security Implications for a Wired India: Challenges Ahead", *Strategic Analysis* (New Delhi), Vol. XXV no.1, April 2001

Ravi Prasad Visweswaraya, "Hack the Hackers", *Hindustan Times* (New Delhi), December 19, 2000

R. Chattopadhay, "The Indian Air Force: Flying into the 21st century", *Bharat Rakshak Monitor* (New Delhi), Volume 3(1) July-August 2000

Shishir Gupta, "Down to Brasstacks", *India Today* (New Delhi), 28 May 2001

S. Jospeh Nye, "American Information Edge", *Foreign Affairs* (New York), Vol. 75 no 5, March-April 1996.

S. K Tripathi, "A perspective for IT: The Army in the Information Age", *Combat Journal*, March 2000

Thierry Gongora, "The Revolution in Military Affairs: What should the CF do about it"? *National Network News* (Vancouver), Volume 5 no. 2, Summer, 1998

Timothy Hoyt, "Modernising Indian Armed Forces", *Joint Force Quarterly* (Washington DC), Summer, 2000

Vinod Anand, "Achieving Synergies in Defence", *Strategic Analysis* (New Delhi), Vol. XXII no.10, January 1999

Willamson Murray, " Thinking about Revolution in Military Affairs", *Joint Forces Quarterly* (Washington DC), Summer 1997.

Newspapers

Hindustan Times
The Times of India
The Hindu
Statesman

Patriot

Newsmagazines

Frontline
India Today
Outlook
The week

Select Online sources

www.mon.nic.in
www.jwar.uk
www.nvu.edu
www.csis.org
www.ipcs.org
www.idsa-india.org
www.sapra.com
www.cdi.org
www.comw.org
www.psycom.net
www.dtic.mil
www.bharat-rakshak.com
www.stratmag.com
www.dtic.mil/jv2010/jv2010.pdf
www.cdi/asoa/fap81600.html
www.atis.org/tg2k
www.IISS.org