

## **EMERGING TECHNOLOGIES AND THEIR IMPACT ON THE DOCTRINES AND CONCEPTS IN THE ARMED FORCES**

*The sword of technology cuts two ways. It can be used in offence – it can destroy an opponent even before his first lunge. But it can also cut the very hand that wields it.*

**- Alvin and Heidi Toffler**

### **INTRODUCTION**

1. Warfare is heading towards fight with satellites, directed energy weapons and in the domain of cyber operations and information warfare. New and emerging technologies have the potential to not only influence the means of warfare but the whole concept, design and conduct of warfare. Technology by itself cannot be a winner in warfare. To be a winner the application of technology in the future battlefield has to be clearly understood. It is therefore essential to comprehend application of emerging technologies in the appropriate military perspective.
2. The technology explosion surging across the world today is challenging the old assumptions and is demanding new ideas and concepts. The technological advances are compelling armed forces to define and restructure old concepts and formulate new ones. Most modern armed forces of the world have already initiated the process of modernisation and absorption of new technologies. Indian armed forces seem to be slow in grasping the full potential of emerging technologies and impact they would have on the future warfare. This paper seeks to analyse the issues related to absorption of emerging technologies by Indian armed forces.



**Aim**

3. The aim of the paper is to analyse the Emerging Technologies and their impact on the Doctrines and Concepts in the Armed Forces.

**Scope**

4. The paper deals with identification of emerging technologies, influence and effect of these technologies on warfare and suggestions regarding changes for effective absorption of technology. The realm of nuclear technology, nuclear weapons and nuclear policy is very vast and is a subject in itself for detailed research and study. Therefore, issues related to nuclear technologies and nuclear weapons are not being included in this study.

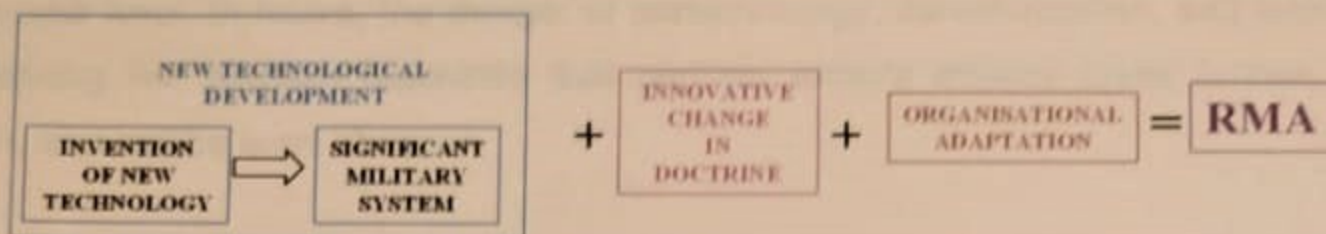
**EMERGING TECHNOLOGIES****Revolution in Military Affairs (RMA)**

5. Definition.<sup>1</sup> RMA is a major change in the nature of warfare brought about by the innovative application of new technologies, which combined with dramatic change in military doctrine, and organisational adaptation fundamentally alters the character and conduct of military operations. Figure 1 below depicts a classic model of RMA along with an example.

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<sup>1</sup> Gp Capt AK Sharma, Impact of RMA in future wars in the Indian Context including limited and Anti-Insurgency operations, College of Air warfare Journal, Summer 2003, P 26.

## REVOLUTION IN MILITARY AFFAIRS



### EXAMPLE

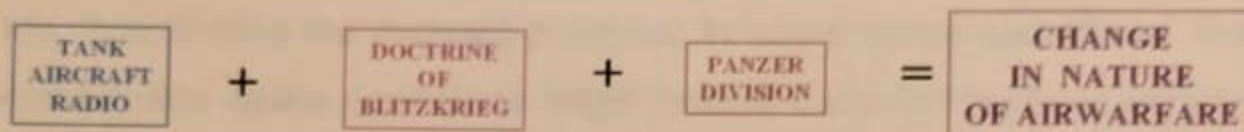


FIGURE : 1

6. Current RMA. Genesis of the current RMA can be attributed to the CHIP. A series of minor RMAs are underway, driven by military application of Chip technology. We are at the threshold of a major RMA resulting from multiple minor RMAs.

### Cutting Edge Technologies.

7. Nano-technology & Miniaturisation. It deals with structures and machines on the atomic and molecular scale. At the extreme, some crystal gazers envision "fire ant warfare,"<sup>2</sup> with the battlefield dominated by millions of small semi-autonomous machines, a few inches to feet in size, networked together and capable of rendering an area impassable to troops or conventional mechanised formations.

<sup>2</sup> Lonnie D. Henley, *The RMA After Next*, *Parameters*, Winter 1999-2000.



8. Biotechnology. Biotechnology<sup>3</sup> is a topic of extensive interest. Endeavor is to improve our understanding of how biological organisms function at the cellular and molecular level. In future, the merger of biotechnology, miniaturisation, and information processing will produce machines that perform today's military tasks farther, faster, better, and maybe even cheaper.

### Aerospace Technology.

9. Space operations greatly differ from air operations. Space is not amenable to human life, thus limiting the manned presence in future space operations. 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 defense systems, small satellites, and both space-based and ground-based distributed networks to reduce the vulnerability of space capabilities.

## EFFECT OF NEW TECHNOLOGIES ON NATURE OF WARFARE

*'In the Information Age, Technological Ideas are becoming the new Index of Power, instead of brute Military Force'*

**- Alvin and Heidi Toffler**

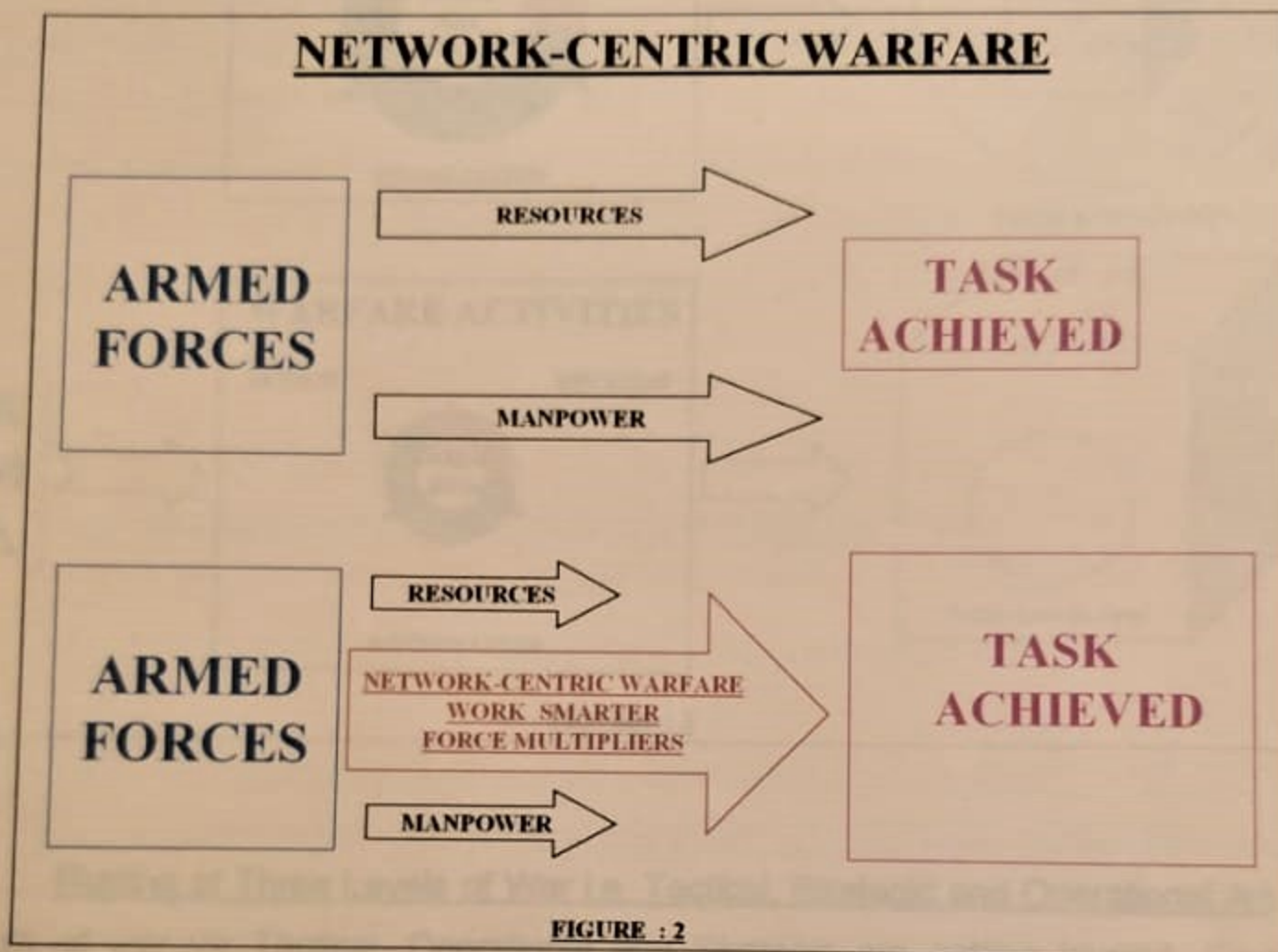
10. New technologies or new combinations of technology have the potential to alter not only tactics and operational methods, but military strategy itself. Major changes in nature of warfare are enumerated in the succeeding paragraphs.

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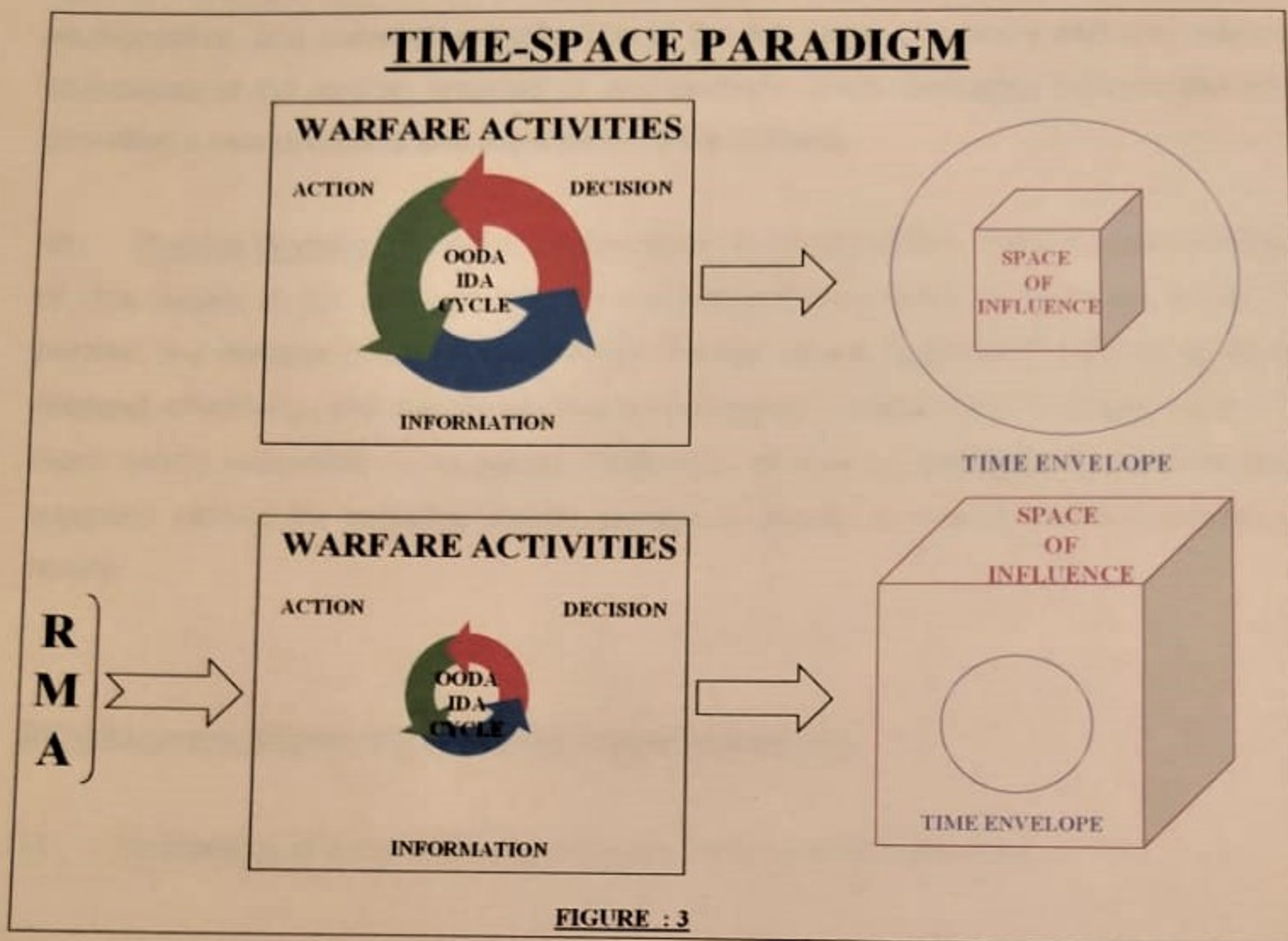
<sup>3</sup> ibid



11. Platform-centric to Network-centric. Warfare is changing from Platform-centric warfare to Network-centric warfare. Translated in simple terms it means that greater task can be achieved with lesser resources by working smarter and utilising force multipliers. Fig 2 below depicts and explains this concept in pictorial form.



12. Alteration of Time – Space Paradigm. Technology is causing a reduction / compression of (Observe, Orientate, Decide and Act) OODA / IDA (Information, Decision and Action) cycle. This in turn is expanding the space of influence and reducing the time period. The whole concept is pictorially depicted in the figure 3 below.



13. Blurring of Three Levels of War i.e. Tactical, Strategic and Operational Art. The levels of war viz Tactical, Operational and Strategic are getting blurred. Emerging technologies have exponentially expanded the battle space and the areas of interest and influence at various levels<sup>4</sup>. As a result there is diffusion and merging of the three levels of war. This is complicating the nature of military planning and decision-making.

14. Effect Based Operations (EBO). EBO<sup>5</sup> is defined as a process for obtaining a

<sup>4</sup> Operational Art, Combat Papers number 12, The College of combat, Dec 2000, P 25.

<sup>5</sup> Charles Tustin Kamps, Effects-Based Operations, *Air & Space Power Journal* - Summer 2004.



desired strategic outcome or 'effect' on the enemy, through the synergistic, multiplicative, and cumulative application of the full range of military and non military capabilities at the tactical, operational, and strategic levels. Emerging technologies are providing a new dynamics and importance to the concept.

15. Parallel Warfare. Strategic organisations, including states, have a small number of vital targets at the strategic level. If a significant percentage of them are struck in parallel, the damage becomes insuperable. Parallel attack deprives him of the ability to respond effectively, and the greater the percentage of targets hit in a single blow, the more nearly impossible is response. Application of new technologies to systems and weapons utilised for targeting enemy centers of gravity is making parallel warfare a reality.

### Simultaneous, Accelerated and Non-linear Operations.

16. Technology is bring following changes <sup>6</sup> in the conduct of battle:-

(a) Simultaneous Operations. Simultaneity means operations across entire geographical jurisdiction of force and it also encompasses all the dimensions of war.

(b) Accelerated Operations. The pace of operations has increased manifold and this trend is likely to continue. This has shrunk and is continuing to shrink the decision loop, thus increasing the tempo of operations.

(c) Non-Linear. <sup>7</sup>The battlefield of the future is likely to be nonlinear

<sup>6</sup> Col Ajeet Bajpai, Emergin Technologies and their impact on the doctrines and concepts in the armed forces, Army War College Journal Spring 2004.

<sup>7</sup> Col RJ Noronha, Battle Field Transparency In Future Conflicts, Dec 2000 P 9



involving simultaneous conduct of operations in the contact, tactical, operational and strategic zones. All parts of the battlefield would remain activated simultaneously. The battlefield would be one of high fluidity, erasing our traditional notions of front, flank and rear.

### Effect of Technology on the Tactical Aspects of Warfare

17. Fluidity. Extremely fluid battlefield would imply that targets would be, mostly, on the move and would offer very little time for reaction by our combat and fire support elements.
18. Manoeuvre. Improved manoeuvre capability contributes to the capability to move over increasingly dispersed area and converge quickly at the decisive point, thus concentrating the effects of both fire and manoeuvre.
19. Dominating Manoeuvre. One of the more recently identified potential new warfare areas is dominating manoeuvre. <sup>8</sup>Dominating manoeuvre can be defined as 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. Dominating manoeuvre would be distinct from manoeuvre in several ways.
20. Firepower and Lethality. In earlier days the lack of accuracy of weapon systems was compensated by heavy rate of fire<sup>9</sup>. Guided weapons have added a new dimension to the battlefield. PGMs allow localising of the destructive power and reduction in

<sup>8</sup> Stefan T Possony, ph.d.; Jerry E. Pournelle, ph.d. and col. Francis X Kane, ph.d. (usaf ret.), The strategy of technology, First edition, copyright © 1970, chapter 3.

<sup>9</sup> Capt Rakesh Vadhyar Op Sit, PP 235-236.



collateral damage. Further increased inventory of PGMs reduces the logistics infrastructure.

21. Reach. Improved mobility and greater range and effectiveness of weapons have increased the areas of influence and scope of manoeuvre in the battlefield. The battlefield is expanding in depth as well as frontage.

22. Redefinition of Mass and Surprise by Stealth and Precision.<sup>10</sup> For the first time in the history of warfare, a single entity can produce its own mass and surprise. It is this single entity of PGM delivery from a stealthy platform that makes parallel warfare possible. Stealth achieves surprise, and precision makes up for the mass.

23. Battlefield Transparency. Advances in surveillance and target acquisition technologies, satellites, unmanned aerial vehicles and various kinds of radars and sensors have made the battlefield transparent to a very large extent.

### New Dimensions of War

24. Information Warfare. Information warfare constitutes another revolutionary aspect of the new era warfare. IW is "any action to deny, exploit, corrupt, or destroy the enemy's information and its functions; protecting ourselves against the actions; and exploiting our own information operations." IW is directed at shrinking or interfering with the enemy's Observe, Orient, Decide, Act (OODA) loop while expanding and improving our own.

25. Cyber Ops. Cyber war is the operational extension of information war however; it is becoming a major constituent of warfare. It involves tactical disruption, then domination, and perhaps even the reordering, of an enemy's decision-cycle.

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<sup>10</sup> John A. Warden III, "Air Power for the Twenty-First Century," in Karl P. Magyar, Editor in Chief, *Challenge and Response: Anticipating US Military Security Concerns* (Maxwell AFB, Alabama: Air University Press, August 1994) PP 328-29.



26. Space Warfare. <sup>11</sup>Space warfare involves dominating the "high ground" of space to deny its advantages to the adversary and to use it to implement one's own applications. <sup>12</sup>It has the potential to become a qualitatively distinct warfare area of its own. 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.

### **Future Battlefield and Likely Operational Environment**

27. Future battlefield and likely operational environment could be summed up as follows:-

- (a) Numbers alone would not indicate strength and capabilities.
- (b) Battle front comprising of dug in positions would be replaced by a totally fluid front extending in multi dimensions.<sup>13</sup>
- (c) War would progress with accelerated pace and rhythm even at night resulting in rapid depletion of assets.
- (d) Battlefield transparency would increase and advances in IT would fundamentally alter techniques and methods of command and control allowing centralised planning and co-ordination of multi functions.
- (e) Command and control over space technology will provide the cutting edge

<sup>11</sup> Stefan T Possony, ph.d.; Jerry E. Pournelle, ph.d. and col. Francis X Kane, ph.d. (usaf ret.), The strategy of technology, First edition, copyright © 1970, chapter 3. .

<sup>12</sup> Ibid, chapter 3.

<sup>13</sup> Capt Rakesh Vadhyar, Op Sit, P 242.



in future battle fields.

- (f) There will be a quantum jump in precision and lethality of weapon systems, thereby increasing the rate of attrition.
- (g) Accent will be on manoeuvre and mobility, rather than on attrition warfare.
- (h) Extended geographical area of operations, simultaneity of operations at all levels and non-linearity of the battlefield and the modus operandi to fight in this environment will assume greater importance.
- (j) Integrated operations would lay more emphasis on jointness. Much higher degree of coordination and integration between the air force and surface forces would be required.

### **SUGGESTED CHANGES IN CONCEPTS AND DOCTRINES**

*"Sheer technical innovations do not win wars. Instead, the interaction of technical change and organisational adaptation within a realistic assessment determines whether good ideas turn into real military capabilities."*

**- Allan Millet**

28. The evolution of three key elements – theory, technology and practice is crucial to the evolution of military power. We need to think in unique and more meaningful ways. Hitherto our military thought on war fighting has been characterised by linear, sequential and less-than-integrated operations. We have been relying on massed forces rather than on massed effects, primarily because of technological inadequacies. **New**



technology demands substantial changes in doctrine, organisations, maintenance philosophies and most of all attitudes.

### Absorption of New Military Technology

29. Military technology has been and is being absorbed by countries worldwide in different forms and up to different levels. In our context the technology is progressing slowly and trying to catch up. The investment in defence technology is related to the state of economy and is secondary to other national interests. Further Indian decision makers are of belief that perusal of peace could avoid military investments. Therefore, acquisition and up gradation of defence systems is a slow process.
30. Revolutionary or Evolutionary Process. In our case the absorption of new military technology would have to be an evolutionary process rather than being a revolutionary one. The process could be classified into three stages:-
- (a) First Stage. *We would have to first optimise the already existing resources. This process could be termed as Partial RMA.*
  - (b) Second Stage. The next step would be to *procure (buy/develop) systems we need and can afford. This could be called a stage of Hybrid RMA.* Currently we are going through both these phases simultaneously.
  - (c) Third Stage. Progressing from Hybrid RMA to the third phase of complete adoption would be a slow, long and continuous process. *We need to maintain focus to pursue the long-term objectives and goals.*
31. Develop or Procure. Sanctions and technology control regimes inhibit free access to sensitive technologies. Ideal solution for meeting the military needs lies in indigenous production. However, In-country capability to design and produce major



systems as turnkey projects has remained extremely modest for a variety of reasons<sup>14</sup>. Another factor that affects the development of technology is the available budget for Research and Development (R&D). Not with standing these limitations, certain EW and software intensive systems need to be developed to achieve self-reliance. ***Therefore, it is essential that we follow the Leap Frog method i.e. while we procure absolute and urgently required systems; simultaneously we encourage and invest in our R&D to meet our future requirements.***

32. Integration with Private Sector. For too long armed forces have remained isolated and aloof from the private sector. Simultaneously along with RMA, RBA (Revolution in Business Affairs) is also happening. This offers an opportunity to ***harness resources of the private sector industry and to use their R&D infrastructure***. Therefore, ***a dynamic interaction between the policy makers, private sector, scientists, economists, military and political leaders needs to be initiated and sustained to continuously analyse and update technology policies***<sup>15</sup>. ***Armed forces would have to involve the private sector in production of defence related systems and other activities. Outsourcing of certain maintenance and training activities may also prove to be beneficial.***

### Doctrinal and Organisational Changes.

33. Doctrine Drives Technology Change Or Vice Versa. The issue whether doctrine should be driven by technological change or vice versa, has been debated for years. Technology absorption may demand substantial changes in doctrine and organisations.

<sup>14</sup> Air Vice Marshal SC Rastogi, AVSM,VSM. Indian Air Force and Technology, USI Journal Apr-Jun 2003, P 249.

<sup>15</sup> Ibid, P 250.



<sup>16</sup>Concepts and organisational structures for exploitation of technology cannot be imported; these would need to emanate from within. ***Qualities like independent thinking, creativity and innovation need to be inculcated and encouraged with far more vigour than before. We need to encourage our think tank establishments and training institutions to brain storm and evolve solutions to doctrinal and organisational challenges arising due to new technology.*** The think tanks would require to change the thought process in pace with developments in military fighting capabilities at strategic, operational and tactical levels to suit the new dimensions of war.

### **Prioritisation of Wish List for Armed Forces**

34. **Definition of Military Objectives and Area of Operation.** New technology offers a variety of systems for military purpose. The wish list could be long but unaffordable. ***There is a need to prioritise and trim the wish list according to the actual needs.*** For this process the beginning has to be made from the top. ***A coherent national policy needs to be evolved, keeping in view the long time security concerns. Thereafter, the steps in sequence would be to identify threats, formulate possible military objectives, list range of response options and evolve a grand strategy.*** This would become the guiding factor for adoption of new technologies by the defence services. Armed forces (especially Air Force and to a large extent Navy) are technology intensive, and stand to gain by going through this process. ***This process should be pursued collectively by the three services through IDS.***

35. **Prioritisation of the Wish List for Armed Forces.** The priority list could be summarised as below: -

- (a) Systems to ***enhance day and night, all weather capability.***

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<sup>16</sup> Kapil Kak, Revolution in Military Affairs – an appraisal, IDSA.



- (b) Systems to provide ***stand off and precision capability***.
- (c) ***Fast, reliable and secure communications*** for flexibility and response.
- (d) Systems to ***enhance and improve survivability***.

### Jointmanship and Interoperability

36. Even though militaries the world over recognise the merits in integrated fighting, the tendencies to keep things up one's sleeves remains. Consequently integration in armed forces continues to remain limited.

37. Joint Doctrine. Joint Doctrine would bring about the required synergy in approach of the three services. ***A Joint Doctrine for the Indian Armed Forces needs to be studied, prepared and practiced.*** An unbiased doctrine must cater to the entire national needs from conventional warfare to LIC and peace keeping.

38. Synergy in Doctrine, Operations and Training. ***Jointmanship would come about through Joint Planning, Joint Training, Joint Logistics and Intelligence flow.*** At present, there is no national or combined defence services posture on modernisation. The three services are pursuing the process independently. This not only leads to duplication of effort, but also could have adverse affect on interoperability. ***Since jointmanship and interoperability are essential, they need to be pursued with more vigour and open mind.*** Formation of IDS, Strategic Command and A&N Command is a good beginning. We need to encourage synergy in doctrine, training and operations.

### Focused and Integrated logistics.

39. Aim of our military logistics network should be to get the right thing to the right



place at the right time. This would require capability to lift and store equipment needed to satisfy users for their multitude of logistical requirements. The characteristics of such a system would include ability to deliver tailored logistics package and sustainment directly at the strategic, operational, and tactical levels. It would also require the capability to track and divert assets en route. These would be possible by adoption of information, logistics and transportation technologies to provide rapid crisis response by flexible and agile combat support organisations. Key technologies today provide us with enablers like automated store handling systems, wireless based tracking system, integrated combat support system and integrated and satellite based communication systems. These could be utilised to form modular and agile national logistics organisation and wide area network of all store holding depots with automated inventory management. ***There is a need to Make a road map and pursue it for formulation of a focused and integrated logistics system.***

#### **Utilisation of Space for Warfare**

40. Space is going to be the battlefield of the future. India is one of the six nations in the world to have built and launched its own satellite. However, ***our space programme needs a far greater military orientation than today***, if the competency in this field has to be exploited in the future. The Army, Navy and the Air Force have to devote increasing attention to space, specifically to “establish requirements, maintain a cadre of space-qualified officers, and research, develop, acquire, and deploy space systems unique to each service.” Indian Air Force has already declared that it is in state of transition to become aerospace power. ***The process needs to be jointly pursued by the three services along with the ISRO and R&D agencies. Armed services should formulate and pursue a road map for exploitation of space and transition to aerospace power.***

#### **Synergised Approach to Information Warfare.**

41. IW is the most important aspect of technology revolution. All the three services



have realised its importance and formulated a road map for its implementation. This is the right step towards giving an impetus to the IW and formulation of the IW/IT doctrine. However, IW should not be tackled in isolation and a national IW strategy needs to be formulated with holistic approach. ***The three services need to work together with the IT task force and formulate and pursue a Joint IT/IW doctrine.***

### **Harnessing Media Power as a Tool.**

42. In the past armed forces have remained isolated from media in the pretext of secrecy. Information Technology has had an enormous affect even on the media. It has become very fast, far-reaching and powerful. Media should be used as a powerful force multiplier. It is very important for winning the support of local masses as well as the world opinion. Armed forces have initiated steps to enhance media management. However, ***we need to open up to the media and allow free interaction at different levels. We need to train our personnel and prepare them for media handling.***

### **Training of Minds**

43. Technology alone cannot ensure desired results, the mind factor is very important. Technology is only one component of the essence of war. ***Warfare still remains a matter of ideas, emotion and will.*** Only well equipped, superbly trained, highly intelligent personnel with high morale will be successful in the incredibly demanding atmosphere of the future.

44. Process of adopting new technology includes recognition, appreciation, implementation and exploitation. This process needs flexibility, adaptability, innovativeness, lateral thinking and openness to change. Most important is the quality of independent thinking. For Armed forces, a far more widespread training and education with the focus on faster transition to a new high technology mindset would be a vital necessity. ***We need to raise the technical threshold of our personnel. There is a need to change our training orientation to develop open minded, thinking***



*personnel proficient in handling the technology warfare. Personnel need to be encouraged to experiment with new doctrines, tactical and operational techniques, organisations and equipment.*

45. Ramifications of new technology need to be understood not only by Military officers at tactical/execution level but also by the strategic planners (both civil and military). ***Armed forces should initiate steps to influence and prepare minds (both within military and relevant external agencies) for adoption of new technologies. This could be done by encouraging research, writing papers, holding seminars and brain storming sessions at different levels and institutions.***

### Leadership Challenges of the Future.

46. Style of Leadership. New technology environment poses new challenges even for the leaders of tomorrow. The leaders would have to possess high degree of mental mobility, improved decision-making, better communication skills and greater ability to withstand combat stress. In tech-savvy environment, the military warriors would become more and more educated, intelligent and aware. In this scenario the leaders would have to understand the increasing and changing demands of and from these warriors. ***They would have to change their style of leadership from Tell type to Sell type, i.e. by explaining and discussing various aspects rather than just by ordering.***

47. Leadership Challenges. Few of these challenges are as follows:-

(a) The challenge would be to recognise and use whatever technology is available; ***to dominate that technology and not get dominated by it.***

(b) ***Foster a military culture where intelligent risk-taking and forward thinking are rewarded***, not dreaded, and to ensuring that visionary leaders who take risks are recognised and promoted.



(c) ***Stay in touch with the reality*** in the cyber world of artificial intelligence.

(d) ***Avoid tendency to interfere in activities of lower formations*** (forward command from the rear) and be able to provide enhanced autonomy and authority to the junior commanders with adequate support from the higher headquarters.

48. Changes in the Art of Decision Making. The importance of "high tech" to today's decision maker has never been greater. Not only has information technology improved commanders' situational awareness, but also it has increased the complexity of the decision-making environment. Advances in communication technology, computers, information systems, surveillance and target acquisition systems have given rise to improved means of command and control to a commander. Perfect real-time information systems are available to base decisions and give directions. In spite of perfect command, control and information systems, the fog of war and uncertainties will continue. The info superiority of the modern battle environment is likely to create information overload. ***The overload would have to be reduced by distributing information and decision-making authority to the junior leaders and employing decision support systems. There is a need to train our leaders to meet the challenges posed by the new technology environment.***

49. HRD: Need for a Change in Approach. Future military warriors working in new technology environment would have to be smarter with high intellectual caliber. We may have to recruit technology savvy personnel. Organisational change may be required in terms of having missile experts, electronic warfare specialists, space warriors and cyber or info warriors. These specialists would be professionals in their respective fields but may not be combat specialists in the conventional sense. Some of them could be women. ***There is a requirement to review and formulate HRD policies for recruitment, employment and career progression of technology savvy specialists.***



## CONCLUSION

50. Trends indicate that technological breakthroughs will continue to be achieved with increasing regularity and they would continue to bestow military advantage on the first nation to develop and use them. The Indian armed forces have realised the need to transform so as to meet the demands of information-age warfare. They are in the process of fielding new technologies and capabilities. However the pace of modernisation is slow due to the existing barriers to the adoption of new technology, doctrine, and organisations.

51. We ought to move beyond marginal improvements so as to harness new technologies that will support a new strategy. Our aim should be to bring the Indian armed forces successfully into the 21st century. A future force that is defined less by size and more by mobility and swiftness, one that is easier to deploy and sustain, one that relies more heavily on stealth, precision weaponry, and information technologies. We need to develop armed forces that are lighter, more mobile, and more lethal, capable of striking across full spectrum with precision.



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