FUTURE WARFARE

Every age has its own kind of war, its own limiting conditions and its own peculiar preconceptions. Each period, therefore, could have held to its own theory of war.

Carl Von Clausewitz

INTRODUCTION

A global technological revolution is leading to social, economic, political and personal change throughout the world like the agricultural and industrial revolutions of the past. The technology revolution with advances in biotechnology, nanotechnology, materials technology and information technology at the vanguard has the potential to transform human quality of life and lifespan, transform work and industry, reshuffle wealth, shift power among nations and within nations and increase tension and conflict. The technology revolution will not be uniform in its effect across the globe but will play out differently depending on its acceptance, investment and a variety of issues such as bioethics, privacy, economic disparity, cultural invasion and social reactions.

Armed forces in 2015 will achieve unprecedented strategic and operational speed by exploiting information technologies to create a knowledge based organization. It will exhibit tremendous flexibility and physical agility through streamlined, seamlessly integrated organizations that use near fantasies and procedures. The collective result will be a versatile, full spectrum, capabilities based force that can decisively respond to any future global contingency.

Major Drivers That Will Shape The World In 2015

Specialists and a wide range of experts have worked to identify major drivers and trends that will shape the world of 2015.The key drivers identified are:-

(a) Demographics.
(b) Natural resources and environment.
(c) Science and technology.
(d) The global economy and globalization.
(e) National and international governance.
(f) Future conflicts.
(g) The role of the United States.

Each driver will have varying impacts in different regions and countries. The drivers are not necessarily mutually reinforcing; in some cases, they will work at cross-purposes. Taken together, these drivers and trends intersect to create an integrated picture of the world of 2015, about which we can make projections with varying degrees of confidence and identify some troubling uncertainties of strategic importance to the country.

Emerging Technologies

Armed Forces the world over are being profoundly influenced by emerging technologies specially in the area of High Energy Physics, Material Science, Bio Technology, Sensor Technology and most predominantly in Computing and Communication Electronics. These technologies, either separately or in combination with one another are acting as engines for development of new weapons systems that promise to change in fundamental ways future wars would be fought. A few specific contributions of these Emerging Technologies in development of weapons systems are enumerated below: -

- **High Energy Physics**. The specific area of high energy physics that promise the maximum pay off is Laser Technology. Laser travels at the speed of light, has a range, which is theoretically infinite in vacuum, and it being mass-less photons of light. These three factors are sufficiently important for serious considerations to be given by defence technologists to the role of Directed Energy Weapons in the future, especially for the destruction of satellites, missiles and aircrafts.
- **Material Sciences**. The contribution this branch of science has made in the sphere of fighter aircrafts and helicopters manufacture is immense, specifically through discoveries of high strength, low alloy steels and polymers that have allowed for significant reduction in their weights. Its application in Armoured Fighting Vehicles has resulted in real tanks having something in common with today's toy tanks, in that they are both being made of plastic. The areas that hold the maximum potential in defence in the years to come is in the realm of nano- technologies, i.e. technologies associated with manufacturing processes at the molecular level. One of the areas where nano-technology is used is in Micro Electronics Mechanical Systems (MEMS), where small groups of atoms are manipulated by microscopic machines to produce, say, a data storage facility wherein 500 Encyclopaedia Brittannicas would fit on a one sq cm chip. This technology has also resulted in the advent of "army ants" – a class of micro-size mobile robots that perform physical tasks and takes co-operative decisions as a coordinated, homogenous team. They derive their usefulness from their group action. Their use in the Armed Forces are manifold – from clearance of mine-fields to carrying out damage control action in a hazardous environment to identification and transportation of inventories in large ammunition or ordnance depots.
- **Bio Technology**. Besides its obvious use in Bio warfare – it takes only Rs 2000 to produce enough anthrax spores to de-populate an area of one square kilometres (for the same damage, a chemical weapon cost would be Rs 5 lakhs), it has a wide range of application. Another exciting area in biotechnology is Bio-molecular Electronics. The ability to design protein molecules that are organised in pre-determined three-dimensional structures gives the prospect of growing circuits. With semi-conductor molecules included in the protein framework, the bio-chip could be self reproducing, regenerative and of high capacity. Militarily, the added advantage could be resistance to EMP effects, as well as a very compact size for a given capacity. In addition, Bio-Technology would be harnessed to manufacture very sensitive and selective bio-sensors, which would be engineered to act as rapid and cheap bio-chemical agent detectors. Bio-Technology also promises break-through in the exotic area of non-lethal technologies.

Biotechnology will begin to revolutionize life itself. Disease, malnutrition, food production, pollution, life expectancy, quality of life, crime and security, will be significantly addressed, improved or augmented . The following appear to be the most significant effects and issues :-

- Increased quantity and quality of human life. Better disease control, custom drugs, gene therapy, age mitigation and reversed memory drugs, prosthetics,

bionic implants, animal transplants and many other advances may continue to increase human life span and improve the quality of life.

- **Eugenics and Cloning**. These will be very controversial developments -- among the most controversial in the entire history of mankind.

Sensor Technology. If miniature devices can detect, process information, move and communicate, they can provide a very fine battlefield sensor network. Some predict the development of small robots, a few inches in size, scattered across the battle space to provide continuous, real time surveillance. Others foresee the development of 'surveillance dust', a cloud of microscopic airborne sensors that could gather and report data for extended periods over large areas. At the extreme, some writers envision 'fire ant warfare', with the battlefield dominated by millions of small machines networked together, recognizing friend from foe, and able to make large areas impassable to enemy troops.

Synergy of Technologies. An exciting system in the realm of converging technologies, currently under development by the United States is the Objective Force Barrier System, an individual soldier's integrated clothing. Research is being done on this subject by the US Institute for Soldier Nano-technologies, which will emphasise revolutionary materials research toward development of advanced soldier protection concepts. This approach will integrate a wide range of functionalities, including multi-threat protection against ballistics, sensory attack, chemical and biological agents; climate control (cooling, heating, and insulating), possible chameleon-like garments; biomedical monitoring; and load management. The objective is to enable a revolutionary advancement in soldier survivability through the development of novel materials.

Characteristics of Modern Warfare Technology. Some of the characteristics of modern warfare technology are given in succeeding paragraphs:-

- Military organizations that can adopt and promote new technologies clearly have a critical edge in "modern" warfare. Adapting the technology developed in the civilian world, such as radios, to military uses was not enough. They had to take the next step and actually foster the development of technology, knowing from experience gained in wartime that this development would be essential. Technology is something that can be deliberately and consciously developed by human beings working within complex organizations. New technology is useless to military organizations unless their members "formulate a doctrine to exploit each innovation in weapons to the utmost."
- Militarily significant technologies are often developed almost simultaneously in different nations. A classic example of this phenomenon is radar, which was under development as a military technology in eight countries (France, the Netherlands, Italy, the United Kingdom, Germany, the United States, the Soviet Union, and Japan) before World War II. Current versions of this same phenomenon are the omnipresent personal computer and wireless phone. Given the often rapid spread of new technology, the question then arises, "Who can best use it as an instrument of war?"
- There is no guarantee that a new technology, once developed in the laboratory or even in prototype form, will receive adequate funding to become

an operational capability. Radar's historical development also illustrates this point.

- The development or refinement of one technology may complement the development of another and lead to results that no one had anticipated. An example is the development of the small, reliable cruise missile in the early 1970s. Adding digital processors to radar seekers and radar altimeters gave improved accuracy, stealthiness, and reliability to this new generation of cruise missiles powered by the smaller, more efficient engine. There are many other cases of such synergy in the historical relationship between technology and warfare. Just having a technology, however, is not enough.
- Military service also needs access to an industry that can produce the equipment embodying that technology in sufficient numbers. Possessing a technology, even in quantity, is no guarantee that it will be decisive in war. With night-vision devices—infrared detectors or visual light magnifiers—modern ground forces can fight round the clock. The availability of these devices, however, does not guarantee that they will be used effectively.
- The relationship of modern technology and warfare is that the military's initial experience with a new technology can reveal problems with making the new capability operational. Over time, as the technology is better understood, the number of systems needed (both experimental and operational) to work out the bugs will decline. This means that a military service may have to invest in a number of prototypes, or even in numbers of different types of operational models, before the technology is proven in operations.
- The result of several decades of experimentation and production can be thought of as a funnel, with many options in the beginning (the mouth of the funnel). Gradually, through tests and the evaluation of actual operations, some technological possibilities are abandoned and others matured. The result is a narrowing of options (the throat of the funnel) and the eventual production of large numbers of standard but sophisticated designs.

Predicting The Future

The machine gun is a much overrated weapon, two per battalion is more than sufficient.

- Field Marshal Sir Douglas Haig

For developing any vision for the future prediction is required. But prediction is risky business under the best of circumstances. Some of the best minds of the world and acknowledged experts in their own fields have been famously wrong in their future predictions. Yet defence planners are called on to make decisions that will depend on the world's state 10, 20 or 30 years out. Some of the infamous predictions are :-

This` telephone' has too many shortcomings to be seriously considered as a means of communication. The device is inherently of no value to us.

- Western Union Internal Memo, 1876.

Who the hell wants to hear actors talk?

- H M Warner, Warner Brothers, 1927.

I think there is world market for may be five computers.

- Thomas Watson, Chairman IBM, 1943.
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There is no reason anyone would want a Computer in their home.

- Ken Olsen, President, Founder and Chairman,
  Digital Equipment Corporation, 1977.

And last but not the least

640K ought to be enough for anybody.

- Bill Gates, 1981.

The above clearly shows that prediction is risky business. However, this does not mean that we should not engage in prediction. By bringing together the wealth of knowledge and expertise throughout the Armed forces, MOD, DRDO and experts in academic and business circle we should reduce the likelihood of errors and can shape the future. Otherwise the future will shape us !

We should not only predict or envision the future, but we must lead the way to its implementation and daily management. The essence of leading is to putting in place the conditions of the success for your successor's success. It means making decisions, sometimes hard. It is not that we take foolish risks. But we should not be so risk averse that we are too conservative and tentative to think or act outside the box.
It is very difficult to forecast which technologies, in what quantity and form, will be incorporated in the military systems of future adversaries. The question is not which technologies provide the greatest military potential but which will receive the political backing and resources to reach the procurement and fielding stage. Moreover, the civilian technology development already is driving military technology developments in many countries.

How To Apply Technology To War

Defense officials have given a great deal of thought for decades about how to apply technology to modern war. There has also been a great deal of progress in recent years in understanding how technologies develop and how they can be adapted to warfare at an acceptable cost to the Nation. In July 1999, for instance, the General Accounting Office of USA published a report entitled "Better Management of Technology Development Can Improve Weapon System Outcomes." This report, described how certain measures, referred to as technology readiness levels, could be used to gauge a technology's maturity. Put another way, the report argued that there were quantitative

means for determining whether a given technology was ready for development in a military acquisition program. Though there is still no consensus within the defense acquisition community that these measures are in fact completely reliable, the work to create and then test them in actual programs is a sign of the progress that has been made in linking new technology to measures of its production (and hence its military) potential.

There will be a shift from chemical explosives in warheads to directed energy weapons. However, chemical explosives and propellants will still be manufactured and used; unguided, chemically explosive small arms and other weapons will have roles for many years to come. For example, chemical explosives can generate electromagnetic pulses to overload many existing digital circuits, thereby giving chemical explosives a new lease on life even in a network-centric battlefield. Such technological developments are examples of how certain existing technologies will have, at least for a while, important roles to play in warfare.

Future weapons (although not necessarily their platforms) will zero in on targets faster. The potential to acquire and share real-time data will grow, and weapons will be able to act on this data to strike mobile targets. Deployment of hypersonic missiles can be expected by 2020, if not sooner. We should, by then, also see missiles that can loiter above a battlefield at subsonic speeds yet are capable of suddenly attacking at *hyper*sonic speeds.

Admiral William Owens, USN (Retd.), former vice chairman of the US Joint Chiefs of Staff, has been saying for years that the critical "revolution" is informational. In *Lifting the Fog of War*, Owens argues that microprocessors were the key element in unmanned aerial vehicle (UAV) development. He defines the *ongoing revolution in military affairs* as "the ability to achieve *integrated sight*—the stage where the raw data gathered from a network of sensors of different types is successfully melded into information."

It is not enough to watch a limited number of critical technologies; a great number have to be tracked and assessed. For example, "Avionics Miniaturization." is possible because computer chips have gotten not only smaller but also more capable and reliable. What technologies have improved so that the chips could get better and smaller and cheaper? Photolithography is one; another is the manufacturing of reliable silicon substrates. Indeed, what we have seen in this particular field is the application of quantum physics to industrial processes, but the details of how this is done are beyond the understanding of even well educated officials. In other words, understanding technology so as to direct it is harder than it was just a few decades ago, and many of the people who understand new technology are not working for the Ministry of Defence. How can their expertise be used to advantage of armed forces?

How, then, are Defence leaders to know which specific technologies to watch and which to invest heavily in? A very interesting recent paper on the military potential of lasers illustrates this dilemma. The author, Mark Rogers, claims, "Laser technology has matured so substantially in recent decades that the United States now has the capability to use lasers from space-based platforms to change radically the conduct of war." Yet he also admits that semiconductor lasers, which are most efficient in converting "input energy into laser light," are not suitable as weapons. Moreover, he acknowledges that "it is difficult to point laser beams with great precision," and therefore it is not easy to keep

the focused beam on the target long enough to destroy it. In consequence, Rogers admits that a space-based laser weapon would be expensive, vulnerable to anti satellite weapons, and face "significant engineering challenges." So what are Defence leaders to do? Invest heavily? Or wait, while investing in limited advanced research projects?
There is no easy answer to these questions because we cannot see the future clearly. One or more nascent technologies may turn out to be "sleepers," apparently useless initially, but very important once developed. For example, there are MOD officials who believe that exotic nonlethal weapons might have a bright military future. There are chemicals that cause metal to turn brittle, for example, and other chemicals that put a stop to combustion in vehicle and aircraft engines, and even sticky foams that could immobilize soldiers without otherwise harming them. It is not possible to predict what new and militarily useful technologies will come out of basic scientific research labs. It is not possible to eliminate technological surprises or to prevent key developing technologies from drawing scarce resources away from investigating exotic but promising new technologies. The balance between pursuing exotic, risky technologies and pragmatic, well-understood technological developments is what is required.
The Armed Forces have to prepare the physical condition and training of soldiers. They must prepare the minds of the next generation of military leaders to handle the challenges of the battlefield. Intellectual preparation must be a recognition of what will not change the fundamental nature of war. The fact is that fog, friction, ambiguity and uncertainty will dominate the battlefields of the further just as they have in the past. We should not forget what the North Koreans, the Chinese and the North Vietnamese were able to do against technologically Superior American forces in 1950s, and 1960s.

Combat in 2015

As the weapons of war change so will the nature of war change, and though this is an undoubted fact, tactically it must not be overlooked that weapons change because civilization changes; they do not change on their own account.

— J.F.C. Fuller

Future Conflicts. What remain to be changed are ideas of how to fight and, from that, with what to fight – the people and the equipment. At root, the existing way of warfare remains focused on a paradigm variously known as attrition, second-generation, or Industrial Age warfare. This style of war-fighting tends to be linear and slow moving, relying on masses of men and material to physically crush (albeit not necessarily through frontal assaults) or threatening to crush an opponent. Industrially, second-generation warfare emulates and relies on mass production techniques to mobilize, train and equip, and deploy military forces. Of course there are exceptions; the high speed attacks of the German Blitzkrieg , U.S. Third Army under Gen. George Patton in World War II and Gen. Douglas MacArthur's daring strike at Inchon in the Korea War come to mind as examples of maneuver or third-generation warfare within the more ponderous methods of their contemporaries. But even these exceptions relied on massed manpower, massed firepower, and massed supplies. Real third-generation war-fighting breaks battlefield linearity by seeking and exploiting a combination of "spaces and timing" vis-a-vis an enemy –that is, creating or at least finding weak points or gaps in enemy thinking and dispositions and taking advantage of these openings before the

opponent can rectify them. The objective of this kind of warfare is to collapse the opponent's will to fight early (ideally, even before becoming decisively engaged) by introducing chaos into his intelligence/surveillance-evaluation/command-action/reaction processes. This can be done by anticipating the actions of the opponent and preempting his intentions via unexpected thrusts and parries by highly agile, dispersed friendly forces brought together quickly for the mission and just as quickly dispersed when the action is finished. This type of warfare also may free forces from the ponderous support structure characteristic of Industrial Age warfare.

Just as second- and third-generation warfare intermingle, they are both interpenetrated by what some call fourth-generation warfare. This primarily involves land forces (although targets can be naval vessels and air assets) –irregular or guerilla warfare carried out by groups motivated by ideology, revenge, lust for power, ethnicity, religion or some other unifying bond. Such irregulars often are associated with or supported by regular military forces, but in the late 20th century this was less often the case. In fact there are countervailing trends. There are more small groups or very loosely knit organizations which employ terror by threatening to or actually attacking civilian populations and infrastructure – the so-called asymmetric style of warfare. Some receive support, safe harbour, or encouragement from nations while others seem to operate with little support. Conversely, regular military forces are trying to reconfigure and redirect themselves toward more rapid force projection. They are responding – albeit at a seemingly slow pace – to the perception that the preponderance of future missions will be low intensity, "stability" ones – peace monitoring, peacekeeping, humanitarian relief support, nation building, and peace enforcement. In one sense, this change in orientation seeks to make the asymmetrical symmetrical by confronting wherever possible the irregular forces on their own terms.

Internal Conflicts. Internal conflicts stemming from religion, ethnic, economic or political disputes will remain at current levels or even increase in number. Some of their characteristics will be :-

- ✓ Many internal conflicts, particularly those arising from communal disputes, will continue to be vicious, long lasting and difficult to terminate -- leaving bitter legacies in their wake. Gujrat is an example.
- ✓ They frequently will spawn internal displacements, refugee flows, humanitarian emergencies, other regionally destabilizing dislocations.
- ✓ If left to fester, internal conflicts will trigger spillover into inter state conflicts as neighboring states move to exploit opportunities for gain or to limit the possibilities of damage to their national interests.
- ✓ Weak states will spawn recurrent internal conflicts, threatening the stability of a globalizing international system.
- ✓ States with poor governance, ethnic, cultural or religious tensions, weak economies and porous borders will be prime breeding ground for terrorism.

Low Intensity Conflict Operations. This being the most likely form of war in the foreseeable future, we need to respond quickly to the needs of LICO. Our important requirements would be as follows :-

- Weapon locating system.

- Bunker location system.
- Detection of trans border movement.
- Mines and IED detection and neutralisation equipment.
- Hand held direction-finding equipment for mountainous and urban areas with accuracy of one degree.
- Voice, radio and radar finger printing.
- Use of non-lethal ammunition from conventional weapons.
- Personnel protection equipment and clothing.
- Surveillance over unheld areas in mountains and deserts.
- Perimeter surveillance and protection.

Information Warfare. As the global society enters the information age, military operations inevitably have been impacted and transformed. Satellite communications, video conferencing, battlefield facsimile machines, digital communications systems, personal computers, the Global Positioning System, and dozens of other transforming tools are already commonplace. The implications of warfare in the information arena are enormous. First, national homelands are not sanctuaries. They can be attacked directly, and potentially anonymously, by foreign powers, criminal organizations, or non-national actors such as ethnic groups, renegade corporations, or zealots of almost any persuasion. Traditional military weapons cannot be inter-posed between the information warfare threat and society.

Even where traditional combat conditions exist (hostile military forces face one another in a terrain-defined battlespace), kinetic weapons are only part of the arsenal available to the adversaries. Indeed, electronic espionage and sabotage, psychological warfare attacks delivered via mass media, digital deception, and hacker attacks on the adversaries' command and control systems will be used to neutralize most traditional forces and allow concentration of fire and decisive force at the crucial time and place in the battlespace.

Warfare in this information age will require enormously complex planning and coordination, very near real time and total situation awareness, decision support systems that filter and fuse information very rapidly and perform simple plan extensions and revisions almost automatically, and massive database and information exchange capabilities to track both friendly and enemy situations as well as rehearse and forecast battlespace dynamics.

Trends in Global Defence Spending

Defence related technologies will advance rapidly particularly precision weapons, information systems and communications. The development and integrated application

of these technologies will occur mostly in advanced countries, particularly the USA. Given the high costs and complexity of technical and operational integration, nations will assign high priority to the indigenous development of such military technology.
Many states would attempt to diversify sources of arms for reasons that vary from fears of arms embargoes to declining defence budgets or to a desire to acquire limited numbers of cutting edge technologies. Their effects would include developing a mix of indigenous production, codeveloping, coproducing or licensing production and purchasing entire weapon systems. The above would suggest the following :-

- Technology diffusion for those few states with a motivation to arm and economic resources to do so will accelerate as weapons and military relevant technologies are moved rapidly and routinely across national borders in response to increasingly commercial rather than security calculations. For such military related technologies as the GPS, satellite imagery and communications, technology superiority will be difficult to maintain for very long. Strategy, doctrine and training will increase in importance in deciding combat outcomes.
- Export regimes and sanctions will be difficult to manage and less effective in controlling arms and weapons technology transfers.
- Advantages will go to the states that have a strong commercial technology sector and develop effective ways to link these capabilities to their national defense industrial base.

If one looks at history, there has not been any war between two real democracies. There will be growing pressure to reduce defence expenditure. Guns Vs butter debate will favour development lobby against defence specially in democratic countries. The policy making bodies and business and industry lobby like CII and ASSOCHEM will exert pressure against war in democratic countries as the expenditure of any war adversely affects the economic development of that country. The emphasis will be acquiring credible deterrence capability so that if required, the country can quickly develop its defence potential manifold within acceptable time frame. After the second world war under the umbrella of USA the defence budget of Japan and Germany were kept low and both the countries prospered. Today even USA wants them to increase defence expenditure. However, these countries have very credible deterrence in terms of economic and industrial might and can develop its defence capability fast, if situation demands.

Technology and System Augmentation

The technologies and systems which are to be augmented by the Army are :-

- **Technology**
  - Hybrid Power Systems.
  - Logistics efficiencies (fuel efficiency ,ultra-reliability, weight reduction).
  - Human engineering/ cognitive engineering.
  - Signature control(including counters).
  - Protection schemes for land systems (including active protection).

- Advanced materials.
- Affordable precision and alternate lethality means.
- Alternative propellants.
- Non lethal capabilities.
- Biological and chemical protection, antidotes and vaccine.

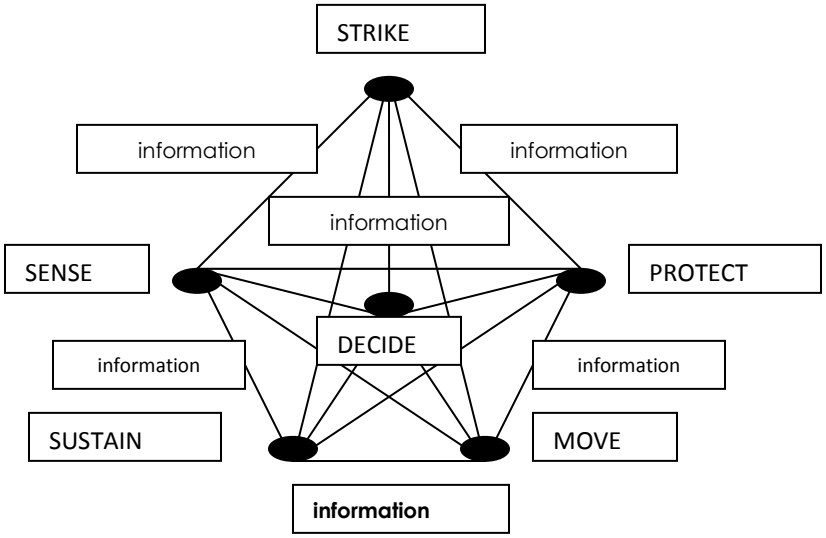
❖ **Systems**

- Situational Awareness.
- Global maneuver platforms.
- Advanced Air frame-Heavy Lift/ Tactical Utility Lift.
- Future Fighting Ground Craft.
- Autonomous and Semi Autonomous unmanned systems (air, ground, sensors).
- Advanced Fire Support System.
- Assured intelligence, surveillance and reconnaissance .
- Soldier as a system.

Warfare Issues. In today's major weapon systems, the six key combat functions are built into the same platform. They are :-

- Protect.
- Sense.
- Decide.
- Movement.
- Strike.
- Sustain.

In the tomorrows systems of system in the era of Network Centric Warfare, the six key combat functions will be distributed across the battlefield in multiple platforms interlinked by information.



CONCLUSION

We have now entered the 21st century, and several serious questions and challenges face our military that must be addressed. The first has to do with the growing number of these nontraditional threats. Will these continue to increase with new types added to the confusing mix, and will we rely on the military as our principal instrument to deal with them? Second, can we afford the kind of military that can meet all the potential challenges ahead that could span the spectrum from conventional warfare with significant capabilities such as weapons of mass destruction to responding to the growing list of asymmetric threats? The third question relates to the much-needed military reform. Can the military change, reform, or transform to meet the challenges of the new century and adapt to the rapid development of new technologies that could radically alter the military as we know it today? The fourth issue deals with interagency reform, which is necessary to move in parallel with military reform. Can we meet the demand for better decision-making and the integration of all instruments of power (political, economic, informational, etc.) to solve the multidimensional challenges ahead?
What really are the essential military implications of the so-called information revolution, for example? On September 11, 2001, terrorists attacked the United States from within. They financed their preparations with funds that had been transferred electronically from banks in the Middle East to banks in America. With those funds, they bypassed the forward-deployed, highly trained, technologically sophisticated forces of the United States. In effect, an apparently “ordinary” electronic funds transfer was a key element in a larger strategy of terror.

As we look to the future we must continually remind ourselves--and our decision makers--that war, notwithstanding its technology, will remain the savage clash that it always has been. We will face adversaries who will not play by our rules and, indeed, who see our values as vulnerabilities. As James F. Dunnigan noted in his recent book on future war, "If the opponents are bloody-minded enough, they will always exploit the humanitarian attitudes of their adversaries. Technology cannot transform war into a gentle electronic exchange as some hope. Perhaps in considering the effect of high technology on warfare, it is worth recalling the words of Vice Admiral Charles Turner Joy from more than 40 years ago: "We cannot expect the enemy to oblige by planning his wars to suit our weapons; we must plan our weapons to fight war where, when, and how the enemy chooses." The future of science and technology is often thought of and described in fantastic terms, even while revolutionary changes are taking place right before our eyes but are not necessarily recognized as such.

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