Chapter 2

Threat

This chapter describes the air and missile threats facing U.S. military forces. This evolving threat will take on new, stressing characteristics during the 21st century. Adversaries will closely observe emerging U.S. capabilities in an effort to identify and exploit weaknesses using asymmetric approaches. An asymmetric approach seeks to negate U.S. capabilities by simple counters and avoids a direct match with U.S. strengths. Fundamental capabilities that 21st-century adversaries may pursue to counter U.S. strengths include weapons of mass destruction (WMD); unmanned reconnaissance, surveillance, and target acquisition (RSTA) systems; precision strike weapons; large numbers of inexpensive rockets; land attack cruise missiles (LACM); and information warfare. Some states will rely on asymmetric capabilities as a substitute for, or complement to, large conventional forces. This trend started in the late 1980s, and is continuing today. The proliferation of low-cost, high-payoff, unmanned systems, theater missiles (TM), unmanned aerial vehicles (UAV), and large caliber rockets (LCR) is a recent trend.

THE EVOLVING THREAT

2-1. Fixed-wing aircraft and helicopters are still formidable threats, however, the trend is toward the proliferation of unmanned systems: ballistic missiles, cruise missiles (CM), unmanned aerial vehicles (UAV), and rockets. The trend toward unmanned threats is driven by cost, training, operational factors and a strategy to counter, rather than match, enemy capabilities. Potential adversaries can obtain a significant number of UAV or CM for the price of one or two highly sophisticated aircraft, without the attendant costs of training, maintaining, basing, and sustaining a manned aircraft fleet. These weapons possess inherently lethal capabilities that stress the defense of the force, and they are increasingly available on the world market. Sophisticated and rudimentary versions of these unmanned systems pose a danger to deployed U.S. military forces. TBMs and CMs can deliver WMD on deployed forces or geopolitical assets. RSTA UAVs can detect U.S. force operations and provide the basis for near real time targeting, leading to potential disruption of decisive operations. Rockets, such as large-caliber multiple rocket launchers (MRL), pose special hazards and challenges across the spectrum of operations. Traditional air threats will still exist in the world of tomorrow. Helicopters continue to pose a significant lethal hazard for ground forces. Fixed-wing aircraft continue to evolve as expensive but highly capable weapon systems.

TACTICAL BALLISTIC MISSILES

2-2. TBMs include short-range ballistic missiles (SRBM) with ranges up to 1,000 kilometers and medium-range ballistic missiles (MRBM) with ranges from 1,000 to 3,000 kilometers. These are surface-launched missiles with ballistic trajectories. TBMs, often launched from highly mobile, difficult-to-detect transporter erector launchers (TEL), have the capability to carry WMD. Most TBMs are single-stage missiles with a circular error probable (CEP) accuracy of one-tenth of one percent of their range. State-of-the-art guidance technologies in some missiles will reduce these errors to less than 50 meters. What makes tactical ballistic missiles (TBMs) threatening? TBMs are inherently difficult to defend against. Characteristics that increase TBM effectiveness include a reduced radar cross section (RCS), high terminal velocity, reduced notification time for defending forces, a variety of difficult-to-kill warheads, and an all-weather capability. The major TBM trends are increased range and improved accuracy.

2-3. Integration of global positioning system (GPS) and terminal guidance are the current focus of improving accuracy. Solid fuels and multiple staging will increase TBM payloads and ranges. Improved TBMs may target point targets. Figure 2-1 illustrates the characteristics of TBMs.

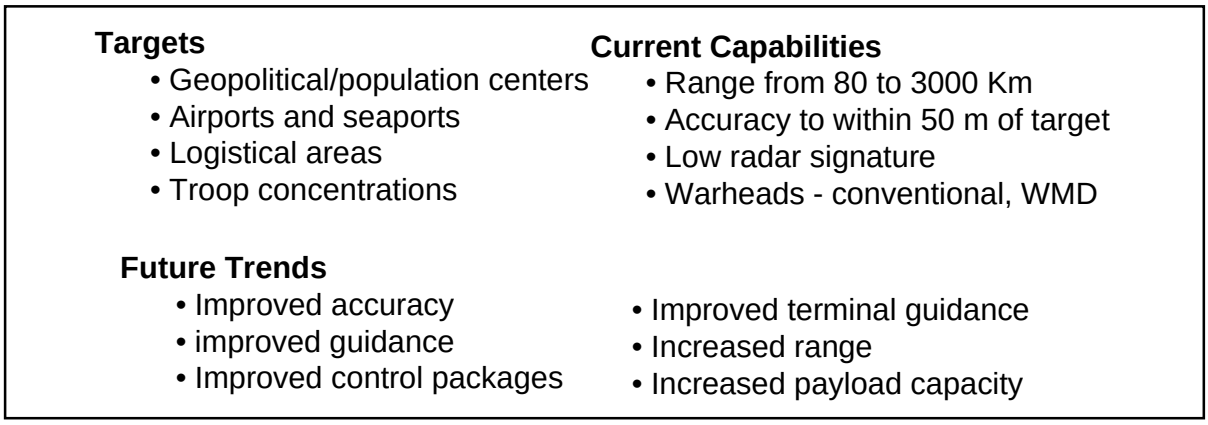

Figure 2-1. Characteristics of TBMs

LARGE CALIBER ROCKETS

2-4. Large-caliber rockets (LCR) are similar to SRBM in size, trajectory, warheads, and battlefield targets. The ability of LCR to deliver high volumes of fire and a variety of warheads makes them ideal weapon systems for fire support missions. Highly mobile launchers effectively support forward artillery missions. This mobility and the rocket's short burn time result in little warning for maneuver forces and their short-range hamper engagement by current missile defense systems.

2-5. Rockets are widely proliferated, and their production and sale is increasing. The high volume of fire and multiple warhead capabilities of LCR make them a very appealing weapon system for threat nations. In the future, threat nations may deploy passive infrared (IR) and radio frequency (RF)

warheads with these missile systems, improving their use against armor systems, command and control nodes, and battlefield radar. Figure 2-2 illustrates LCR characteristics.

Targets
- Assembly areas
- Air defense/FA locations
- Defensive positions
- Troops in the offense
- Choke points/advance routes

Current Capabilities
- High rates of fire;rapid reload
- Highly mobile(“shoot & scoot”)
- Low signature flight trajectory
- Warheads - all types

Future Trends
- Passive infrared sensors
- Advanced antiarmor warheads
- Increased range -- in excess of 150 Km

Figure 2-2. Characteristics of Large Caliber Rockets

CRUISE MISSILES

2-6. Cruise missiles (CM) are unmanned, powered, self-guided vehicles that exhibit sustained flight through aerodynamic lift at one or more predetermined, constant (cruise) altitudes and carry a warhead or other lethal payload. There are two types of CM: antiship cruise missiles (ASCM) and land attack cruise missiles (LACM). The Army is obviously most concerned with the LACM. For ease of discussion and unless otherwise noted, "CM" will denote the LACM. Cruise missiles are reliable, accurate, survivable, and lethal. They can be launched from the land, air, or sea; in flight, they are difficult to detect, can fly indirect routes (low or high) to avoid heavily defended areas, and can attack from any direction. Today's CM can hit a target with remarkable accuracy; tomorrow's smarter and more accurate CM will pose a far greater threat. Although only a limited number of LACM are currently available, numerous countries have ongoing development programs. These CM should become operational around 2000. What makes CM threatening? Emerging CMs pose serious threats because of their unique operational characteristics. The incorporation of new technologies in airframe and warhead design, propulsion systems, and guidance systems has contributed to vastly improved systems. The increased use of composite materials in airframe construction has created stronger and lighter airframes. A range of low observable and stealth technologies has reduced the RCS.

2-7. Increased use of air-breathing turbojet and turbofan engines permits subsonic speeds, providing longer ranges and flight altitudes as low as 20 meters above ground level (AGL). Sophisticated guidance systems, such as GPS, the inertial navigation system (INS), and terrain contour matching (TERCOM) contribute to overall accuracy and allow programming of unpredictable flight paths to optimize surprise. A terminal guidance seeker increases accuracy up to less than 10 meters. A wide array of conventional

warheads, to include submunitions, allows targeting of both soft and hard targets. NBC weapons pose the most serious threat, but currently very few countries have CM with nuclear warheads. However, the development of a chemical or biological warhead is not difficult. The May 1997 Quadrennial Defense Review report noted that the use of NBC weapons is a likely condition of future warfare, and that these weapons could be delivered by several means including CM. The success of cruise missiles in Operation Desert Storm led to increased interest in these systems and spurred current worldwide developments. Threat experts foresee an increase in the number of LACM within the next ten years, as well as extended ranges, improved accuracy, reduced RCS, and increased lethality. The addition of smart submunitions will allow the engagement of armored units on the move in the near future. Countermeasures and evasive maneuvers are also potential capabilities. Figure 2-3 illustrates cruise missile characteristics.

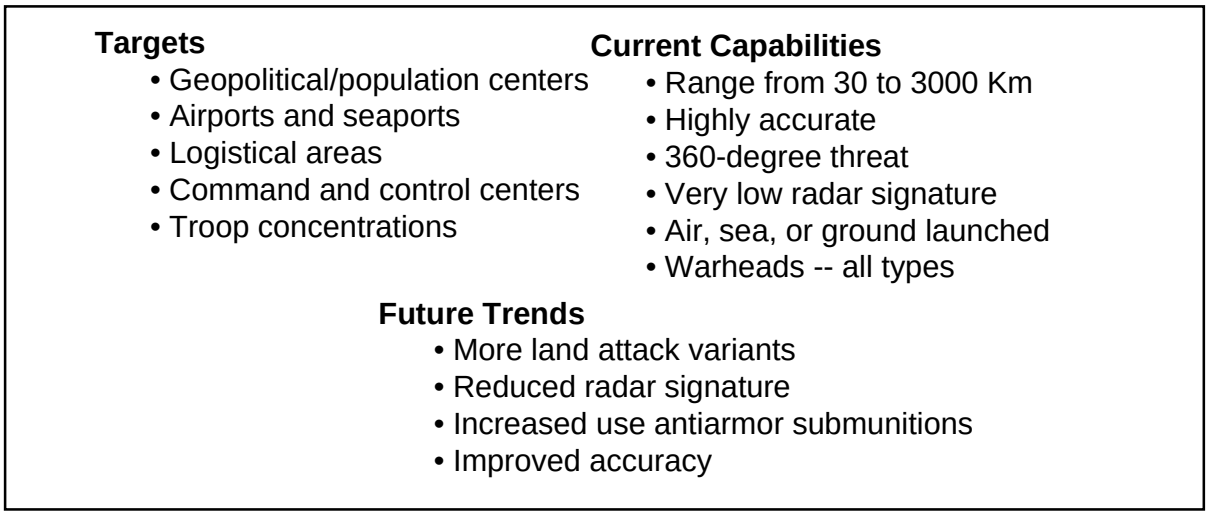

Figure 2-3. Characteristics of Cruise Missiles

AIR-TO-SURFACE MISSILES

2-8. Air-to-surface missiles (ASM) are air-launched, precision-guided munitions designed to strike ground targets. They are ideal against targets, such as bridges, that are difficult to destroy with "dumb" bombs. They are similar to air-launched CMs, but are smaller, have shorter ranges, lack the wings and aerodynamic lift associated with CMs, and are launched by tactical fighter-bomber aircraft. The former Soviet Union and free world countries widely export ASM, and they are operational in numerous air forces around the world. What Makes ASM threatening? ASM are an extremely lethal threat because of their versatility and pinpoint accuracy. Most threat ASM are of Soviet or Russian origin and employ radio command, laser, anti-radiation homing, or electronic-optical guidance systems.

2-9. Missiles that employ anti-radiation homing systems are referred to as anti-radiation missiles (ARMs); they represent the greatest threat to air and

missile defense, artillery (counter-battery), aviation, and intelligence radar. Most ARMs have ranges of over 100 kilometers. An aircraft firing an ARM will usually launch from outside the lethal envelope of the air defense system being attacked. Laser-guided systems place the attacking aircraft in harm's way because of their short range, generally less than 10 kilometers. Electro-optical or video-guided systems and ARMs offer the greatest standoff range and aircraft survivability factor. Some electro-optic systems have ranges in excess of 100 kilometers.

2-10. ASM, like CM, are becoming smarter and more versatile, reliable, accurate, and lethal. New capabilities may include a lock-on-after-launch capability or a loitering capability to attack enemy radar (for ARM variants) and may use dual mode seekers for increased reliability and combat capability. Figure 2-4 illustrates ASM characteristics.

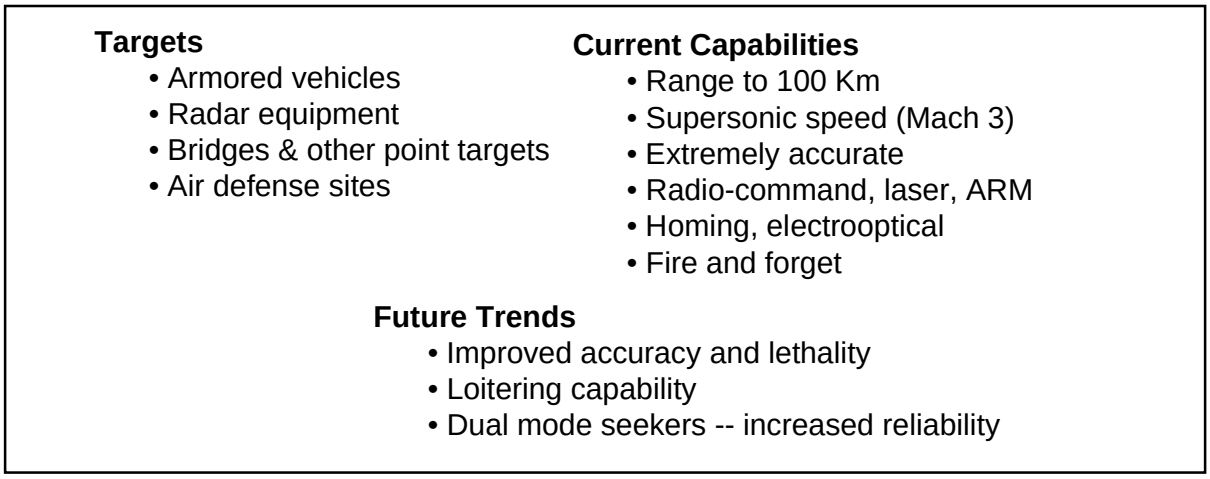

Figure 2-4. Characteristics of Air-to-Surface Missiles

UNMANNED AERIAL VEHICLES

2-11. UAVs include drones, characterized by preprogrammed flight paths and patterns, and remotely piloted vehicles (RPV), controlled by ground-based operators. Each can perform a variety of missions, ranging from reconnaissance and battlefield surveillance to attack and electronic warfare. What is it that makes UAVs threatening? UAVs serve as RSTA information platforms for target detection, identification, and location; weapon targeting; target designation; and battle damage assessment. State-of-the-art sensors and data links provide near real-time targeting for fire support systems, maneuver forces, and aircraft. UAVs equipped with laser designators provide immediate targeting of assets for attack by smart munitions. The UAV's small RCS, low speed, and small thermal signature make them difficult to detect and engage. Mission-dictated flight profiles take full advantage of terrain, increasing system survivability and optimizing coverage. Flight altitudes are normally between 1,000 to 3,000 meters AGL. UAV conducting RSTA missions fly at altitudes safe from small arms fire.

2-12. UAV payloads consist of daylight television and IR video cameras, and film cameras (for reconnaissance missions). Other major payload categories include electronic warfare (EW), electronic intelligence (ELINT), radar, and attack warheads. Several nations are developing and fielding anti-radiation homing UAV with the primary mission of attacking battlefield RF emitters (radar, communications). These platforms have a variety of launch options and are usually fire-and-forget systems. Other attack UAV systems employ terminal guidance to kill tanks or fighting vehicles.

2-13. Current projections indicate more than 50 developer countries and 75 user countries of UAVs by 2005. In addition to information gathering (still the dominant function), UAV roles will include electronic attack, decoy, ground attack, and suppression of enemy air defense (SEAD). A significant new capability involves the direct linkage of a reconnaissance UAV to an artillery unit's fire direction center. This linkage provides near real time information to ground commanders, followed by immediate fire and damage assessment. UAVs are also good candidates for stealth technology and spin-off technologies from CM developmental programs. Figure 2-5 illustrates UAV characteristics.

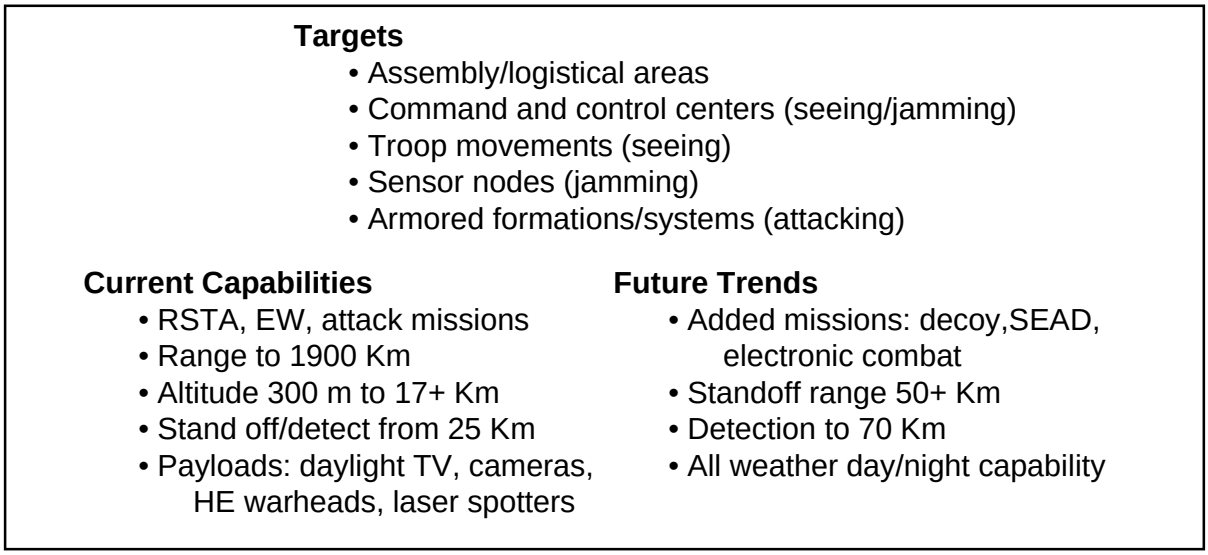

Figure 2-5. Characteristics of Unmanned Aerial Vehicles

HELICOPTERS

2-14. Most countries maintain helicopters to support military operations. The majority of the helicopters are utility systems that are, or can be, armed to perform a variety of roles, thus offering an inexpensive and effective substitute to the more expensive attack helicopter. The versatility and survivability of helicopters make them ideal for use in most combat areas. What makes helicopters threatening? Threat ground-force commanders primarily rely on helicopters to fulfill direct air support requirements. Helicopters can perform a variety of missions. Hovering and low-flying helicopters, taking full advantage of terrain masking, are difficult to acquire

and target. Better fire control and weapon capabilities will enable helicopters to search, acquire, and fire at ground targets from longer standoff ranges, thus increasing their survivability and effectiveness. Figure 2-6 illustrates helicopter characteristics.

2-15. Attack and armed utility helicopters have improved technical capabilities that focus on ground-attack capabilities using enhanced fire control and aircraft survivability equipment. The best technology trends that stand out are:

- Retrofit of existing airframes with modular upgrades.
- Modular equipment (the main focus being electro-optical sensors, weapons, and electronic attack equipment) that facilitates maintenance and reduces cost.
- Expanded night and adverse weather capabilities.
- Improved fire control systems and engagement capability (standoff hovering attacks at greater distances with much improved accuracy).
- Improved IR countermeasures against IR-seeking missiles.

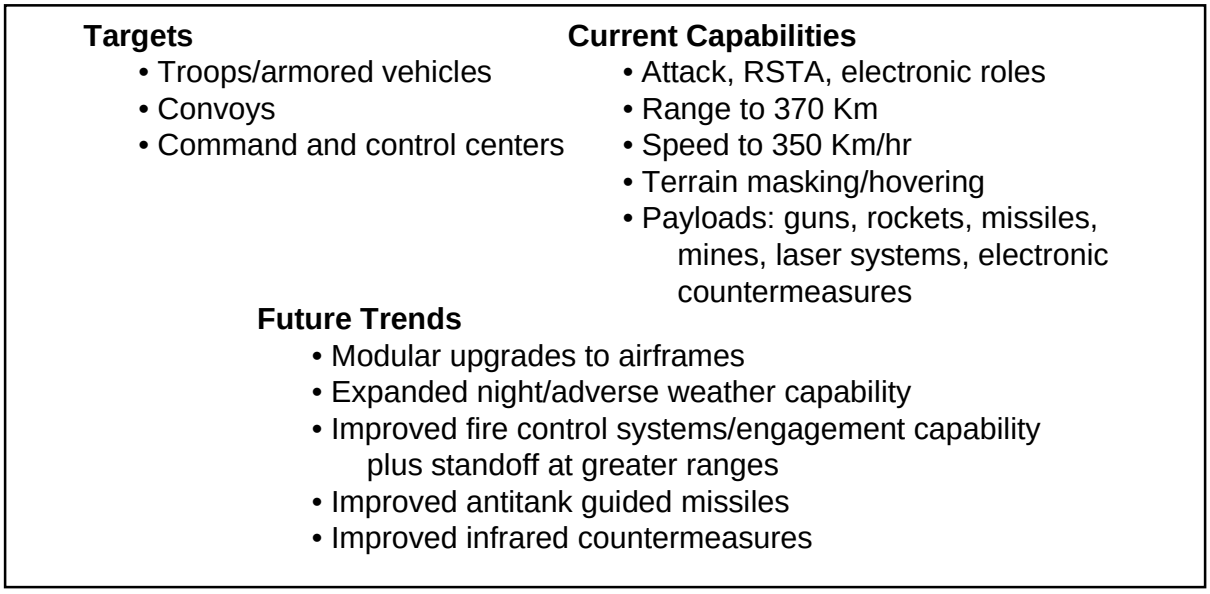

Figure 2-6. Characteristics of Helicopters

FIXED-WING AIRCRAFT

2-16. Fixed-wing aircraft no longer present the most challenging threat to air defenders, however they remain a formidable threat. Coalition air power during the 1991 Gulf War provided the world with a remarkable demonstration of the capabilities of well-employed fixed-wing aircraft. There are more than 30,000 operational military aircraft today; of these, some 8,000 (many of which were Soviet produced) are in third world inventories. Some 45 countries have an aviation industry of some kind, and 21 countries design their own aircraft. While the Soviet Union was once the leading exporter of combat aircraft, today the United States, France, and Russia are the leaders.

What makes Fixed-Wing Aircraft threatening? Fixed-wing combat aircraft perform a variety of missions in both offensive and defensive operations: air interdiction, strategic attack, SEAD, and close air support. Fixed-wing aircraft can employ a variety of munitions, including guns, rockets, CM, and ASM. Integrated navigation/bombing computers and related mission equipment provide new combat aircraft with a precision-strike capability during day or night and in bad weather. In addition, new aircraft incorporate such features as radar warning receivers (RWR), on-board radar jammers, chaff, flares, and a smaller RCS to improve survivability and mission success rate.

2-17. Technological advances in low observable materials, aerodynamics, power plants, armaments, and aircraft systems has resulted in highly capable, but very expensive, aircraft. With the cost of a new fighter aircraft approaching $50 million, aircraft inventories will probably steadily decline. There will be a move toward multirole capabilities, rather than dedicated, single-mission platforms, and an increased use of precision, standoff munitions. Aircraft survivability continues to improve with incorporation of advanced EW suites, advanced countermeasures development, and reductions in radar and IR signatures. The upgrading of current aircraft capabilities will continue, rather than one-for-one replacements with next-generation aircraft. Figure 2-7 illustrates fixed-wing aircraft characteristics.

Targets

- Ports and assembly/logistical areas
- Command and control centers
- Geopolitical/population centers
- Armored vehicles/formations

Current Capabilities

- Roles: CAS, SEAD, RSTA, electronic warfare, interdiction, attack
- Precision strike
- Mission equipment: missiles, guns, rockets, bombs, WMD

Future Trends

- Multiroled versus single-mission aircraft
- Greater use of precision and standoff munitions
- Reduced radar and infrared signatures
- Integrated electronic warfare suites

Figure 2-7. Characteristics of Fixed-wing Aircraft

ELECTRONIC WARFARE

2-18. With the demise of the Soviet Union in 1991, the focus of electronic warfare against the air threat and ground based air defense has shifted from large fleets of standoff jammer aircraft to individual self-protection systems onboard fighter-bombers. This trend toward self-protection systems has extended to helicopters, and may evolve to UAVs and land attack cruise missiles (LACM) in the future.

WEAPONS OF MASS DESTRUCTION

2-19. Any nation with the will and resources can turn their legitimate nuclear, medical, and chemical industries to weapons production. This threat exists in all regions of the world, from states with long-established programs to those with emerging capabilities. Despite the dissolution of the Warsaw Pact, the downfall of communism in the former Soviet Union, and extensive efforts to negotiate treaties that would reduce the number of nuclear weapons and eliminate chemical and biological weapons from military arsenals, the number of countries pursuing NBC weapons programs continues to increase.

2-20. Russia and China currently possess nuclear weapons and there are many other nations of nuclear proliferation concern. As many as 26 countries are developing, or are suspected of developing, chemical weapons.

2-21. Principal doctrine for chemical weapons use by threat nations is to maintain the momentum of an attack and to degrade their enemy's capability to fight. Chemical and biological agents can be delivered to target areas virtually anywhere in a theater of operation. Delivery means include ballistic missiles, aircraft bombs or rockets and spray, multiple rocket launchers, mortars, conventional artillery, CM, UAV, and Special Forces.

2-22. Nuclear weapons cause casualties and materiel damage through the effects of blast, thermal radiation, and nuclear radiation. Biological agents, consisting of pathogens and toxins, produce diseases in soldiers, thereby reducing their ability to accomplish their missions. These agents are primarily an inhalation threat. Threat forces will employ chemical agents to expose soldiers to a respiratory and percutaneous agent threat by attacking with non-persistent and persistent agents. Persistent agents will also be used to contaminate personal clothing, equipment, and materiel. This will mandate the diversion of resources to decontaminate personnel and equipment.

2-23. Insurgent or terrorist groups could manufacture or acquire chemical and biological weapons to attack AD forces and other high-payoff targets. Small laboratories, such as school labs, or the drug labs used for processing cocaine, can produce some chemical and biological warfare agents.

2-24. Threat nations will employ NBC weapons to incapacitate or kill personnel. In addition, unit effectiveness decreases while operating in a contaminated environment due to fear, the requirement to wear protective clothing, and the need to decontaminate personnel and equipment. ADA units throughout the theater will be high-priority targets for NBC attack. The air defense commander and staff must, therefore, train their soldiers and units for operations in an NBC environment.

SUMMARY

2-25. Numbers of countries with the potential to present regional challenges to the United States and its allies will increase. While traditional air threats, such as fixed-wing aircraft and helicopters, will continue to improve, the acquisition of new, lower-cost, unmanned threats such as ballistic missiles, CMs, UAVs, and LCRs will add greater lethality. Ballistic missiles, in addition to being effective terror weapons, will have a more significant

military role as their range and accuracy improve. Cruise missiles are difficult to detect, highly accurate, and can attack from any direction. UAVs will add new attack, decoy, and targeting missions, though still emphasizing the traditional reconnaissance mission. LCRs, with multiple types of warheads available and long-range, high rates of fire, are another deadly threat. The use of WMD is a likely condition of future warfare, and many of the unmanned threat platforms are capable of delivering such weapons. These emerging threats present a serious challenge to ADA units. The regional proliferation of technologies and sophisticated weapons continues to grow (figure 2-8).

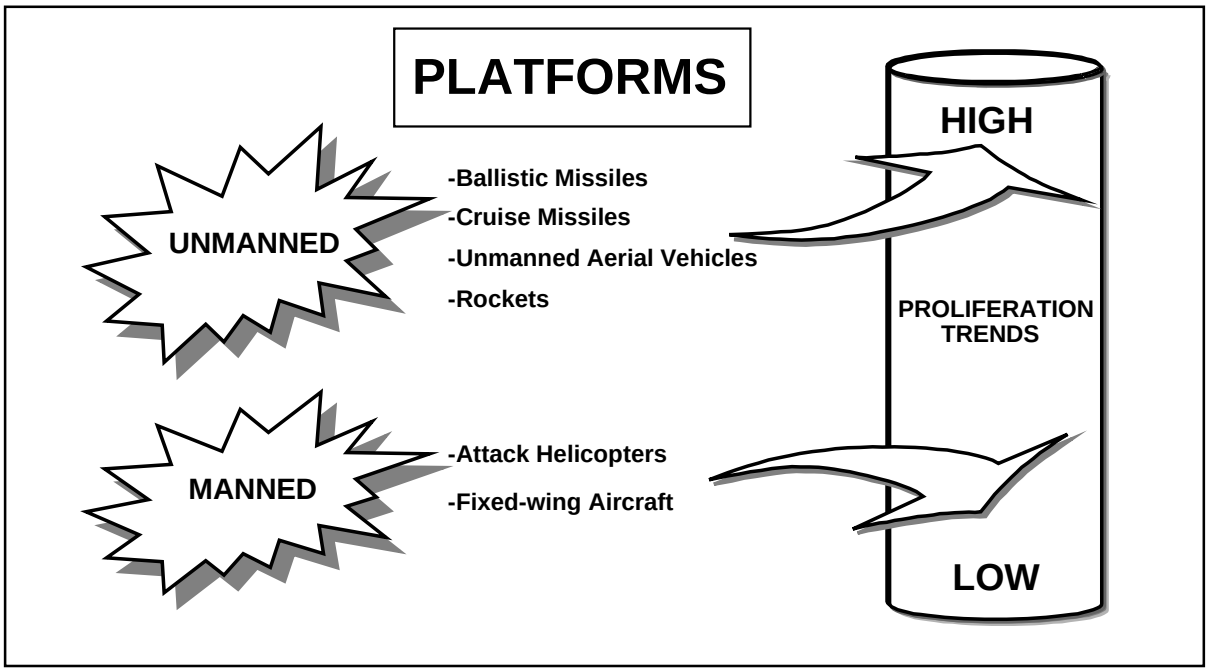

Figure 2-8. Trends in Weapons Proliferation