Threat Capability Assessment for Canada's Fighter Aircraft Capability

INTRODUCTION

This assessment is an updated version of an unclassified report produced in February 2013. The changes incorporated herein provide a focus on threat capabilities. Both reports have been developed to meet an RCAF requirement for an unclassified version of the Threat Assessment for Task 1 (Threat Analysis) of the Work Plan for Evaluation of Options to Sustain a Canadian Forces Fighter Capability (6451-300002527-102 VOL 0001, Oct 2012, DRAFT).

This Threat Capability Assessment describes threats to Canada and Canada's interests in the context of a Canadian Armed Forces (CAF) fighter aircraft capability. Threats are characterized in terms of military capabilities (e.g., weapon systems, technology) and an actor's intent to use the capabilities. Potential threats against CAF fighter aircraft in tactical operations are also described.

ASSESSMENT OUTLINE

As part of the Assessment process, CDI identified several global Regions, including Canada/USA, as areas having the greatest intelligence interest out to the year 2030. Within each Region, the countries of greater significance were examined as a means of further refining the problem set. The Assessment identified and described the key threat systems that will likely exist in each Region over two specified time horizons, taking into account future technology and weapon system developments and their proliferation.

The Threat Assessment was structured on the following elements:

a. The Executive Summary from the current Canada-United States (CANUS) Combined Threat Assessment 2011-2031 was incorporated to provide a means of framing the potential and perceived threats against Canada and North America during this timeframe. This assessment had been produced jointly by the defence intelligence authorities of Canada and the United States, independently of the Fighter Capability Task 1. It factored heavily into developing both the Annex A Threats Matrix and Annex B Targets Matrix.

b. A Time Horizon Summary provided an overview of the general technological trends during these Horizons;

c. Air threat trends to 2030 that assist in outlining where both current and future threat systems will be in service and also proliferated. This section also provided an outlook to 2030 of threat intent;

d. An analysis of future technological trends described the forecasted trends for each threat class (e.g., Aircraft, Surface to Air Missiles, Man-Portable Air Defence Missiles, Jammers, etc.) and target class (e.g., tanks, anti-tank guided missiles, etc.) across all time Horizons; and

e. Two Annexes included detail of major elements of the Assessment:

   i. Annex A: Threats Matrix (Horizon 1)[1]. An unclassified version is included in Annex A herein; and

   ii. Annex B: Targets Matrix (Horizon 1).

CANADA-UNITED STATES COMBINED THREAT ASSESSMENT 2011-2031

The Canada-United States Combined Threat Assessment is intended to assist senior government and military planners in the preparation of plans for the joint defence of North America. It highlights for decision-makers the CANUS (Canada-United States) security environment that may emerge during the next 20 years. The CANUS Region and North America are defined as the continental land mass of Canada and the United States, Alaska, all contiguous waters, and the airspace above. This estimate does not attempt to assess the vulnerabilities of potential targets in the Region.

The Combined Threat Assessment describes the broad range of possible threats across the broad spectrum of both conventional and unconventional threats and how those threats might manifest themselves.

[1] An Unclassified version of this Annex is provided in Annex A to this Assessment as a means of displaying how the classified information is presented.

TIME HORIZON AND REGIONAL STRUCTURE

Future threats were assessed in two time horizons according to the expected operational era of threat weapon systems:

a. Horizon 1: 2020-2030; and

b. Horizon 2: Beyond 2030.

To structure the Assessment, several global Regions were identified (e.g., South-east Asia, Middle East and Africa) and considered as areas of intelligence interest out to the year 2030. Within each Region, countries were identified that are considered to have primary intelligence interest and specific threat capabilities.

CONSTRAINTS

The Assessment uses a set of representational threat systems, rather than a full listing of all known threats. These representational systems cover the range of technology for a given threat grouping. Any conclusions drawn after analyzing the data provided can be readily assumed to be factual over the broad range of threat systems.

KEY ASSUMPTION

It is postulated that if there is a current trade relationship between two states/parties, then there will likely be an opportunity for the trade of military hardware and technology in the future

THREAT TRENDS TO 2030

THREATS TO CANADA

Foreign military weapons that could threaten Canada up to 2030 will grow in direct correlation to technological improvements made by potential adversaries, both state and non-state. Future threat aircraft will likely have the ability to fly further, faster and higher than current threats as well as have an increased payload potential. Missiles, capable of high speeds and capable of being launched from land, air and maritime platforms, could also present threats to Canada. Additionally, naval aircraft carriers will likely become more prevalent as emerging states envisage their use to project power.

ARCTIC BASIN

As the polar ice cap recedes, the development of new trade routes and the exploitation of natural resources will become more common, possibly leading to disputes. Therefore it would be in the interest of any country whose territory either abuts the Arctic Circle, or lies north of the Arctic Circle, to field military equipment capable of sovereignty defence in what will still be a fairly inhospitable environment for a good deal of the year.

REGIONAL THREAT CAPABILITIES

Certain foreign states will continue to maintain significant military power and capabilities. The ability to project military force beyond their territorial limits, for example into the Arctic Basin region, will increase. Several states will continue to be major global arms suppliers and will likely continue to maintain current military equipment trade relations as well as seek exports to new customer states.

The instability or demise of state's regimes is setting a trend which could allow for weapons, such as Man Portable Air Defence Systems (MANPADS), to be proliferated or distributed to other states or third party regional entities.

Developing countries that are rich in natural resources may likely allocate funds disproportionately towards military capabilities, ostensibly for defence. Regional spending trends will most likely be influenced by mistrust and tensions between neighbouring countries. It is possible that other key military states with relatively high Gross Domestic Product (GDP) will have the opportunity to seek modern military equipment. As well, countries could be likely to opt for spending money on advanced air defence systems in lieu of purchasing and training a fighter aircraft force. This has the perceived advantage of adequately denying access to airspace while still having a relatively low cost-to-benefit payoff ratio.

Many states are likely to remain committed to military modernization in the long term. Several states, for example, plan to acquire advanced fighter aircraft capabilities and/or to develop new aircraft carriers.

Certain nations are likely to increase their expenditure on advanced military technology and weapon systems as a possible means of countering other nations' bids for regional dominance. These states will take advantage of emerging technologies as they become more affordable and manageable.

The expanding availability of Western military technology could possibly enable non-aligned countries to acquire and operate relatively sophisticated aircraft and to field advanced air defence systems.

CONCLUSION: AIR THREAT TRENDS TO 2030

Geopolitics will continue to influence the proliferation of military technology. In general, customer states of proliferated military hardware will depend on foreign sources rather than developing their own indigenous technology. Future export trends of specific military technology which is considered cutting edge will likely be balanced between necessities for profit and strategic risk-benefit considerations of the state of origin.

THIRTY YEAR OUTLOOK OF THREAT INTENT

The future is difficult, if not impossible, to predict with certainty. It is possible in the broadest context only to describe what might happen based on certain enduring conditions, both human and environmental.

Although Canada does not currently face a threat of attack by any major state, the risk posed by the significant military capabilities possessed by these states – especially the advanced weapons systems foreseen in the next thirty years – cannot be ignored. Furthermore, while non-state actors, terrorists and criminals may not yet have the capability to attack Canada with sophisticated weapons, it is possible that they could gain such capabilities over the next thirty years as availability through proliferation expands.

In the next thirty years, shows of force or projections of power will continue to be exercised by states interested in gaining regional prominence. Conflicts are likely to remain local in nature. However, potential conflicts could evolve into major state-on-state events that could further escalate to encompass other nations.

Economic disparity in many Regions of the world will be a source of tension, potentially resulting in conflict or aggressive responses to threats to trade or economic well-being. Moreover, the possibility of civil unrest or insurgency could lead to a requirement for Canada's participation in humanitarian or stabilization missions in Regions equipped with sophisticated weapons systems.

In summary, while it is not realistic to predict where the next future conflict will occur in the world, it is reasonable to predict that there will continue to be human conflict for the next thirty years.

FUTURE TECHNOLOGICAL TRENDS

This section describes the forecasted technological trends for each threat class across both time Horizons. Definitions for each threat class are provided in Annex B.

LOW-OBSERVABLE TECHNOLOGIES

The term "Stealth" is a misnomer that suggests invisibility to some; rather, the term "Low-Observable" is more precise. Low observable (LO) treatments are designed to reduce target signature through a combination of techniques. Although counter-stealth technologies will continue to advance, low-observable design is expected to be an essential design element for advanced fighter aircraft, along with other types of threat aircraft and missile systems, for the foreseeable future. While low-observable design features do not guarantee survival, not having these design features would make a threat aircraft a more visible target. Conversely, defensive weapons systems will need to implement counter-LO technologies – such as advanced radar and electro-optical sensors – to aid in the detection of low-observable aircraft. Such advanced technology will likely be out of reach of many states, at least in the Horizon 1 timeframe.

FIGHTER AIRCRAFT TRENDS

Fighter aircraft can be characterized as either “progressive-design” or “new-design” aircraft.

Progressive-design aircraft are typically modified variants of existing airframes such as the Russian Su-30 variants and MiG 29 variants of a similar vintage. The common definition of a progressive-design aircraft are aircraft that have advanced capabilities, such as AESA (Active Electronically Scanned Array) radar, a high capacity data-link along with enhanced avionics and the ability to deploy current and reasonably foreseeable advanced armaments.

New-design fighter aircraft are characterized by being designed to operate in a network-centric combat environment and to feature extremely low, all-aspect, multi-spectral signatures employing advanced materials and shaping techniques. Current new-designs typically focus on multifunction, high capacity, long range, multi-track radars with high-bandwidth, low-probability of intercept (LPI) data transmission capabilities. New-designs also incorporate infra-red search and track sensors for air-to-air combat as well as for air-to-ground weapons delivery. These sensors, along with advanced avionics, glass cockpits, helmet-mounted sights, and improved secure, jamming-resistant low-probability of intercept data links are highly integrated to provide multi-platform, multi-sensor data fusion for vastly improved situational awareness, while easing the pilot’s workload. Avionics suites rely on extensive use of very high-speed integrated circuit technology, common modules, and high-speed data buses. Other technologies common to new-design fighters include integrated electronic warfare system technology, integrated communications, navigation, advanced identification technology, thrust-vectoring and super cruise capabilities.[2]

It is expected that as digital processing power increases, new-design fighter aircraft will likely incorporate sophisticated data fusion engines, thereby providing not only the pilot but, through high-bandwidth data transfer, other air and ground-based platforms and command and control systems with real time intelligence grade information.[3]

[2] http://en.wikipedia.org/wiki/Fighter_aircraft

[3] See e.g., Yannone, RM, Exploring Architectures and Algorithms for the 5 JDL/DFS Levels of Fusion Required for Advanced Fighter Aircraft for the 21st Century, May 1999, accessed 18 Feb 2014 at http://www.megasociety.org/noesis/167/9.htm

FUTURE SURFACE-TO-AIR-MISSILE (SAM) TRENDS

States will continue to upgrade current analog air defence systems with digital upgrades resulting in significant capability enhancements. Digital technology will also make it easy to link the various systems together and merge the data at the national level to provide command and control nets with a very accurate common operating picture (COP). Digital enhancements will also ease the transfer of targeting information to other digitally enhanced systems. Future SAM systems will most likely employ digital technology that allows each system to be easily and effectively operated by only moderately skilled personnel.

Recent trends in SAM development that are expected to continue include increased mobility, longer engagement ranges and the use of "fire-and-forget" missiles.

FUTURE MAN PORTABLE AIR DEFENCE SYSTEMS (MANPADS) TRENDS

MANPADS will continue to proliferate to both state and non-state actors. Recent developments in MANPADS have been focused on improved counter-countermeasure (CCM) performance and improved ease of use, along with a variety of other enhancements. Future fighter aircraft will, as a minimum, need to incorporate low-observable technologies, in particular low electro-optical and infrared signatures, as an aid in countering MANPAD improvements.

FUTURE ANTI-AIRCRAFT ARTILLERY (AAA) TRENDS

AAA Guns are widely used throughout the world as part of Ground-based Air Defence Systems. These AAA systems are often the same as those mounted on naval vessels, and modified versions of the same cannons equip many fighter aircraft. The current trend in development is for greater integration of AAA systems with their associated fire-control systems and Early Warning networks into more fully Integrated Air Defence Systems (IADS).

FUTURE AIR-TO-AIR MISSILE (AAM) TRENDS

Current AAM technology enhancements translate into longer ranges, faster turn rates and more responsive manoeuvres. More aerodynamic control and better sensors will increase the ability and lethality of air-to-air missiles. Future fighter aircraft will need low-observable technology as one of the means of countering AAM advances.

FUTURE EARLY WARNING / GROUND CONTROLLED INTERCEPT TRENDS

The future of early warning (EW) radar systems will likely see the continued employment of digital technologies combined with advanced software algorithms to improve the capability of high-frequency (HF), very high frequency (VHF) and ultra high frequency (UHF) radars. These systems will have improved system reliability, low-altitude detection performance, and target recognition. Increasingly these systems, through improved data extraction, will be seamlessly integrated into a country's integrated air defence system (IADS) to automatically disseminate target track data to the command and control (C2) network in order to be able to vector fighters in a ground-controlled intercept mode.

FUTURE AIRBORNE EARLY WARNING (AEW) AND CONTROL TRENDS

Advanced AEW aircraft are being sold to developing countries. In general, these aircraft will come equipped with the latest in active electronically scanned arrays (AESA) radar technology. Data fusion is continuing to improve, permitting data from a variety of other platform sensors to be fused with data from the AEW platform's sensors. Future fighter aircraft will need low-observable technology as one of the means of countering AEW radar advances.

FUTURE AIRBORNE ELECTRONIC WARFARE TRENDS

Electronic Attack (EA) platforms provide several functions including escort and standoff jamming (targeting fighter, air defence, and early warning radars), Global Positioning System (GPS) jamming, and communications jamming. Airborne passive detection systems can also be used for Electronic Signals Intelligence (ELINT) and Communications Intelligence (COMINT) applications if equipped with the proper avionics. ELINT collection is essential to support data fusion, to detect emissions from fighter aircraft and to detect other low probability of intercept radars and avionics.

FUTURE AIRBORNE MARITIME PATROL AIRCRAFT (MPA) TRENDS

Any nation looking to protect its maritime interests is likely to employ some degree of maritime patrol capability. Depending on their intended roles, MPA can utilize a variety of sensors including electronic support measures (ESM), ELINT, radar, electro-optics, Light Detection and Ranging (LIDAR), magnetic anomaly detectors, and acoustics to conduct their missions or deploy weapons to attack surface, sub-surface and land-based targets.

FUTURE AIRBORNE JAMMERS/DEFENSIVE AID SUITES (DAS) TRENDS

The future of airborne self-protection jammers will see digital technology increasingly used to upgrade older airborne self-protection jammers. Older aircraft are expected to be retrofitted with federated defensive aids suites, whereas new aircraft (e.g., fighters, helicopters, and transports) will be fitted with fully integrated capabilities. Future fighter aircraft will be required to incorporate anti-jamming technologies if they are to successfully operate in this realm.

FUTURE DIRECTED ENERGY WEAPONS TRENDS

Directed-energy and laser weapons are designed to disrupt, degrade, and destroy personnel, sensors, electronics, and structures. They can be used alongside air defence artillery (ADA), SAMs, and integrated air defence networks, or can stand alone. DEWs can use the same target-acquisition and tracking systems used by other weapons systems. These types of weapons generate intense beams of concentrated energy using either RF at microwave or millimeter wavelengths or lasers operating at IR or visible wavelengths. Laser and radiofrequency weapons (RFWs) are line-of-sight (LOS) weapons in which energy travels from the beam source to the target at the speed of light. Target damage mechanisms range from sensor and critical electronics degradation, upset, or destruction (soft kill) to catastrophic structural failure (hard kill).

FUTURE THREAT TO GPS TRENDS

The future threat to GPS will see a greater proliferation of GPS jamming capability with many countries having some degree of GPS jamming capability by 2025. Basic GPS jammers will become smaller and cheaper. Small size, easy construction and low cost will be attractive to non-state actors, as well as to smaller nations.

FUTURE ANTI-SHIP CRUISE MISSILES (ASCM) TRENDS

Future trends will see ASCM’s flying further and much faster. Future fighters conducting support to maritime operations will need to use AESA radar to be able to successfully find and engage the newer ASCMs.

FUTURE LAND ATTACK CRUISE MISSILE (LACM) TRENDS

The low observability and signature of both the launch and the flight envelope of LACMs and precision guidance will enable them to be a potent threat to all static installations. There will be a requirement for defending aircraft to be equipped with AESA-type radars and a data fusion capability to distil numerous clues to aid in target detection and elimination.

WEAPON SYSTEMS DENIAL AND DECEPTION TECHNIQUES

Hostile forces will make use of camouflage, concealment, and deception (CC&D) material and Denial and Deception (D&D) techniques to confuse the battle-space in an attempt to make it difficult to detect and subsequently attack these targets. Adversaries are likely to deploy weapon system decoys, dummies, or derelicts to protect operational systems from attack. Future fighter aircraft will need sophisticated algorithms to sift through all the sensor data in order to discern a real target from a sophisticated decoy.

FUTURE UAV TRENDS

UAVs are likely to continue to be proliferated and will continue to increase in capability. As UAVs continue to become more reliable, manufacturers will continue to increase the capability of the payloads. Payloads on UAVs will mirror those available on manned platforms.

FUTURE BOMBER TRENDS

Bombers can be used to drop conventional or guided bombs or launch long range missiles. As missile ranges increase bombers may be able to conduct attacks by launching missiles from well within protected areas. Bombers will continue to be equipped with advanced electronic countermeasure equipment including jammers, increasing their chances of survival when operating far from fighter support. Bombers are also capable of carrying electronics intelligence equipment to improve their threat libraries.

Future bombers will likely employ various low-observable technologies, along with other technologies similar to those to be incorporated on advanced fighter aircraft.

This product has been prepared by the Canadian Forces Intelligence Command, Directorate of Scientific and Technical Intelligence.

ANNEX A

ILLUSTRATIVE THREAT MATRIX

The tables shown below illustrate the structure and main elements of the Threat Matrix. The threat indications are for illustrative purposes only.

Threat Matrix

Systems		Regions/Countries								Continental
Threat System		Region A	Region B	Region C	Middle East and Africa	Caribbean and South America	South-West Asia	South-East Asia	Arctic Basin	Threats To Canada
Fighter Aircraft										
A Highest Threat System		X					X		X	X
B			X		X			X		X
C		X	X		X					X
D		X	X	X		X	X	X	X	
E										
Z Lowest Threat System			X	X	X	X				X
Long Range Surface to Air Missile (SAM)										
A		X	X		X				X	
B			X		X			X		
C			X	X	X	X	X	X		

Threat Matrix (Part 2)

Systems	Regions/Countries								Continental
Threat System (SAMPLE SYSTEMS)	Region A	Region B	Region C	Middle East and Africa	Caribbean and South America	South-West Asia	South-East Asia	Arctic Basin	Threats To Canada
Naval Surface to Air Missile (SAM)									
Ground Based Anti-Aircraft Artillery (AAA)									
Air-to-Air Missile (Beyond Visual Range)									
Electronic Warfare/Ground Control Intercept									
Airborne Electronic Warfare/Warning & Control									
Airborne Electronic Attackk/Support Measures)									
Airborne Jammers									
Ground Based Jammers/Synthetic Aperture Radar/Jammers									
Threat to Global Positioning Systems									
Land Attack Cruise Missiles									

ANNEX B

THREAT CLASS DEFINITIONS

DIRECTED-ENERGY WEAPON (DEW)

A directed-energy weapon (DEW) engages its target by causing physical or functional changes through the effect of radiated energy rather than through the effect of a physical projectile or mechanical blast. Unlike a jammer, a DEW is intended to have effects that last beyond the exposure to radiated energy. The radiated energy from a DEW may be carried by electromagnetic radiation, (laser weapons and radio-frequency weapons) highly-energetic subatomic particles (particle-beam weapons) or sound waves (acoustic or sonic weapons).

ANTI-AIRCRAFT ARTILLERY (AAA)

Projectile weapons with related equipment, such as searchlights or radar, employed on the ground or on ships to strike at airborne aircraft or missiles. Abbreviated AAA.

FIGHTER AIRCRAFT

A fighter aircraft is a military aircraft designed primarily for air-to-air combat against other aircraft, as opposed to bombers and attack aircraft, whose main mission is to attack ground targets. However, some fighter aircraft are capable of delivering ground weapons as well. The hallmarks of a fighter are its speed, manoeuvrability, and small size relative to other combat aircraft.

Fighter aircraft are designed primarily to secure control of essential airspace by destroying enemy aircraft in combat. Designed for high speed and manoeuvrability, they are armed with weapons capable of striking other aircraft in flight.

SURFACE-TO-AIR MISSILE (SAM)

A guided missile designed to be fired at an airborne target from the ground or from the deck of a surface ship. SAMs can be guided using different methods, including command guidance, passive IR or RF, semi-active and active seekers. They can pose a significant threat to all aircraft types.

MANPADS

Man-Portable Air-Defence Systems (MANPADS) are shoulder-launched surface-to-air missiles that can be fired by an individual or a small team of people. MANPADS are typically guided weapons with IR seekers. They can pose a significant threat to low-flying aircraft that do not have effective countermeasures (CM), especially helicopters.

AIR-TO-AIR MISSILE (AAM)

An air-to-air missile (AAM) is a missile fired from an aircraft for the purpose of destroying another aircraft. AAMs are typically powered by one or more rocket motors; usually solid fuelled but sometimes liquid fuelled. Tracking of enemy aircraft can either be accomplished by the AAM itself or the launch aircraft, different methods of tracking can be employed, including: radar, and infrared.

EARLY WARNING RADAR

An early warning radar is any radar system used primarily for the long-range detection of its targets, i.e., allowing defences to be alerted as early as possible before the intruder reaches its target, giving the defences the maximum time in which to operate. This contrasts it with systems used primarily for tracking or gun laying, which tend to be shorter range but offer much higher accuracy.

Over the Horizon Radar (OTHR): Over-the-horizon (OTH) radar usually uses HF surface wave, HF sky wave, and VHF surface wave radiation to detect targets beyond the optical horizon. Surface wave radars achieve OTH capability by directing their radiated energy through surface ducts that occur for vertically polarised energy over a conductive surface such as salt water. Surface wave radars can have a range up to 400 km. Sky wave radars achieve OTH capability by refracting their signal off the ionosphere, creating a radar footprint well beyond the horizon. They have a minimum range of around 800 km and a maximum range of around 3500 km in a single hop.

All of these systems provide real-time, all-weather, long-range surveillance of both sea and air targets.

AIRBORNE EARLY WARNING AND CONTROL

An airborne early warning and control (AEW&C) system is an airborne radar system designed to detect aircraft, ships and vehicles at long ranges and control and command the battle space in an air engagement by directing fighter and attack aircraft strikes. AEW&C units are also used to carry out surveillance, including over ground targets and frequently perform C2BM (command and control, battle management) functions similar to an Airport Traffic Controller given military command over other forces. Used at a high altitude, the radars on the aircraft allow the operators to distinguish between friendly and hostile aircraft hundreds of miles away.

AIRBORNE ELECTRONIC WARFARE

Any aircraft whose primary function is to perform one or more electronic warfare roles. This can include the use of electronic counter measures or electronic support measures. ECM includes using the electro-magnetic spectrum to degrade the operation of tracking systems, communication systems, and missiles. This can include the use of electronic counter measures, electronic support measures, or optical interference. Electronic Support Measures (ESM) can be used to locate and identify potential threats by detecting emissions from other platforms.

MARITIME PATROL AIRCRAFT (MPA)

A maritime patrol aircraft (MPA), also known as maritime reconnaissance aircraft, is a fixed-wing aircraft designed to operate for long durations over water in maritime patrol roles—in particular anti-submarine, anti-ship and search and rescue.

AIRBORNE JAMMER/DEFENSIVE AIDS SUITE (DAS)

Electronic countermeasures (ECM) is practiced by nearly all modern military units—land, sea or air. Aircraft, however, are the primary weapons in the ECM battle because they can "see" a larger patch of earth than a sea or land-based unit. When employed effectively, ECM can keep aircraft from being tracked by search radars, or targeted by surface-to-air missiles or air-to-air missiles. On aircraft, ECM can take the form of an attachable underwing pod or could be embedded in the airframe. Active Electronically Scanned Array (AESA) radars like those mounted on the MiG-35 can also act as an ECM device to track, locate and eventually jam enemy radar. Previous radar types were not capable of performing these activities due to the inability of the antenna to use suboptimal frequencies, the processing power needed, the impossibility to practically intermix or segment antenna usages. Fighter planes using a conventional electronically scanned antenna mount dedicated jamming pods instead or may rely on special-purpose electronic warfare aircraft to carry them.

ANTI-SHIP CRUISE MISSILE (ASCM)

Anti-ship cruise missiles are guided missiles that are designed for use against ships and large boats. Most anti-ship cruise missiles are of the sea-skimming variety, and many use a combination of inertial guidance, satellite navigation and radar homing. A good number of other anti-ship missiles use infrared homing to follow the heat that is emitted by a ship; it is also possible for anti-ship missiles to be guided by radio command all the way. Many ASCMs have a secondary role as a Land Attack Cruise Missile.

LAND ATTACK CRUISE MISSILE (LACM)

A cruise missile is a guided missile the major portion of whose flight path to its target (a land-based or sea-based target) is conducted at approximately constant velocity; that relies on the dynamic reaction of air for lift, and upon propulsion forces to balance drag. Cruise missiles are designed to deliver a large warhead over long distances with high accuracy. Modern cruise missiles can travel at supersonic or high subsonic speeds, are self-navigating, and can fly on a non-ballistic, extremely low altitude trajectory. They are distinct from unmanned aerial vehicles (UAV) in that they are used only as weapons and not for reconnaissance. In a cruise missile, the warhead is integrated into the vehicle and the vehicle is always sacrificed in the mission.

WEAPON SYSTEM DECOYS

Weapons countermeasures are active and passive techniques and devices designed to defend against weaponry by evading detection by the weapon's targeting system or operator, reducing the weapon's ability to hit the target, and limiting the damage done by the weapon.

UNMANNED AERIAL VEHICLE (UAV)

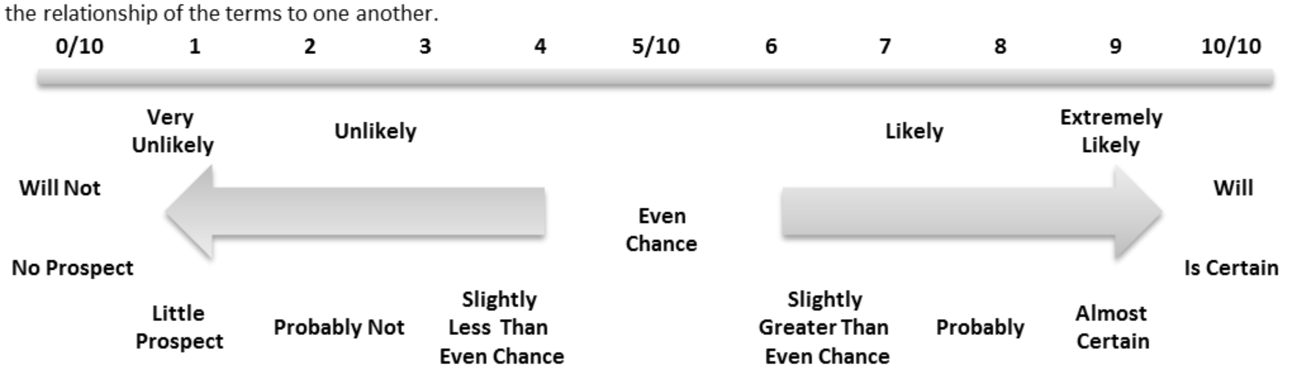
An unmanned aerial vehicle (UAV) is an aircraft without a human pilot on board. Its flight is either controlled autonomously by computers in the vehicle, or controlled remotely. UAVs are primarily used for intelligence, surveillance and reconnaissance (ISR), but can also be used in electronic warfare applications, and can be armed with a variety of weapons

BOMBER

A bomber is a military aircraft designed to attack ground or sea targets, by deploying a variety of weapons. Strategic bombers are heavy bombers primarily designed for long-range bombing missions against strategic targets such as supply bases, bridges, factories, shipyards, and cities themselves, in order to damage an enemy's war effort. Tactical bombing, aimed at enemy military units and installations, is typically assigned to smaller aircraft operating at shorter ranges, typically in coordination with land and sea-based units.

CDI Analytic Confidence Guidelines (What we mean when we say…)		
Confidence Level	**Sample language**	**The level of confidence is based on…**
Complete Confidence	We have complete confidence…, We know…, We are certain…, We are positive…	▪ Evidence – Totally reliable and corroborated. ▪ Assumptions – None. ▪ Reasoning – Undisputed.
High Confidence	We assess with high confidence…, We judge…, We expect…, We see…, We do not see…	▪ Evidence – Well corroborated, relevant information from proven sources, extensive databases, and/or historical understanding of the issue, with negligible risk of deceptive influence. ▪ Assumptions – Minimal. ▪ Reasoning – A mix of strong logical inferences developed through multiple analytic techniques or an established, repeatable methodology.
Moderate Confidence	We assess with moderate confidence…, We believe…, We anticipate…, We infer…, We estimate…, We doubt…, We think…	▪ Evidence – Uncorroborated, relevant information from good or marginal sources (a mix of semi-proven sources who have fairly accurate) with some databases and/or historical understanding of the issue, but with some risk of deceptive influence. ▪ Assumption – Several; some critical to the analysis. ▪ Reasoning – A mix of strong and weak inferences developed through single analytic techniques or an established methodology.
Low Confidence	We assess with low confidence…, We consider…, We surmise…, We suggest…, We cannot discount…, We have some basis/ indication/ evidence/ information/ reason to believe…	▪ Evidence – Uncorroborated, relevant information from good or marginal sources (a mix of semi-proven sources who have been somewhat accurate and/or new, unproven sources) with some databases and/or historical understanding of the issue, but with considerable risk of deceptive influence. ▪ Assumptions – Many; most critical to the analysis. ▪ Reasoning – Dominated by weak inferences developed through few analytic techniques or methodologies.

As intelligence analysis is seldom based on perfect knowledge, CDI uses specific probabilistic words to express the likelihood of an assessed development or event. The number scale is not intended to suggest precision, but should be used as a guide to understanding the relationship of the terms to one another.



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