

Engineering, Ethics and Society: Military Engineering Ethics

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Engineering 183EW, UCLA SEAS
Lecture 15

Lecture Contents

- Defense Establishment
 - The “Military-Industrial Complex”
 - DoD and DHS
- Defense Engineering Environment
 - Budgets and expenditures
 - Current policy drivers
 - Current technical thrusts
- Case 1: Ethical Analysis
 - Overview
 - The “Laws of War” and “Rules of Engagement”
 - Just Wars: Purpose, Conduct, Consequences
- Case 2: Current Technologies and Implications
- Case 3: Societal Reactions
- Final Thoughts and Further Study

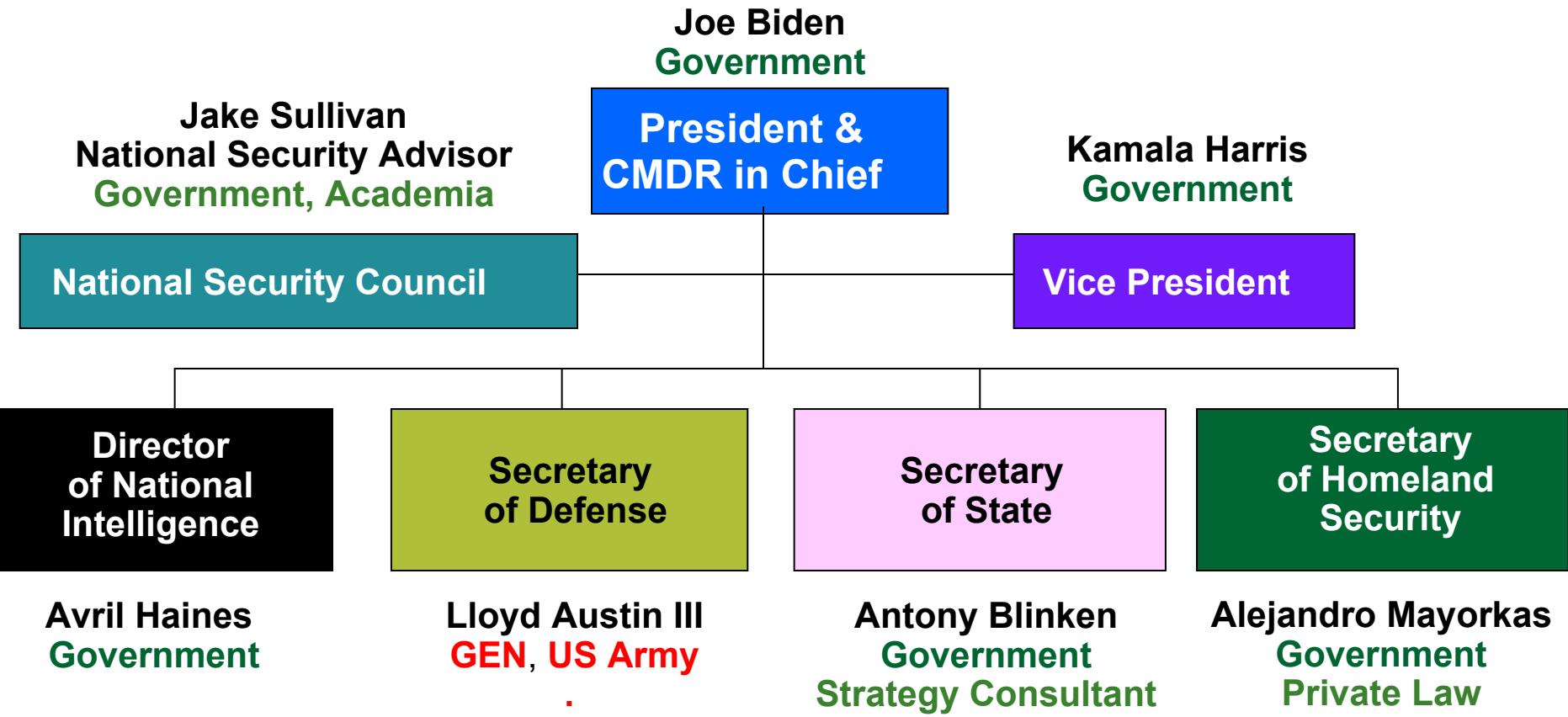
The Military-Industrial Complex

“In the councils of government, we must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex. The potential for the disastrous rise of misplaced power exists and will persist.”

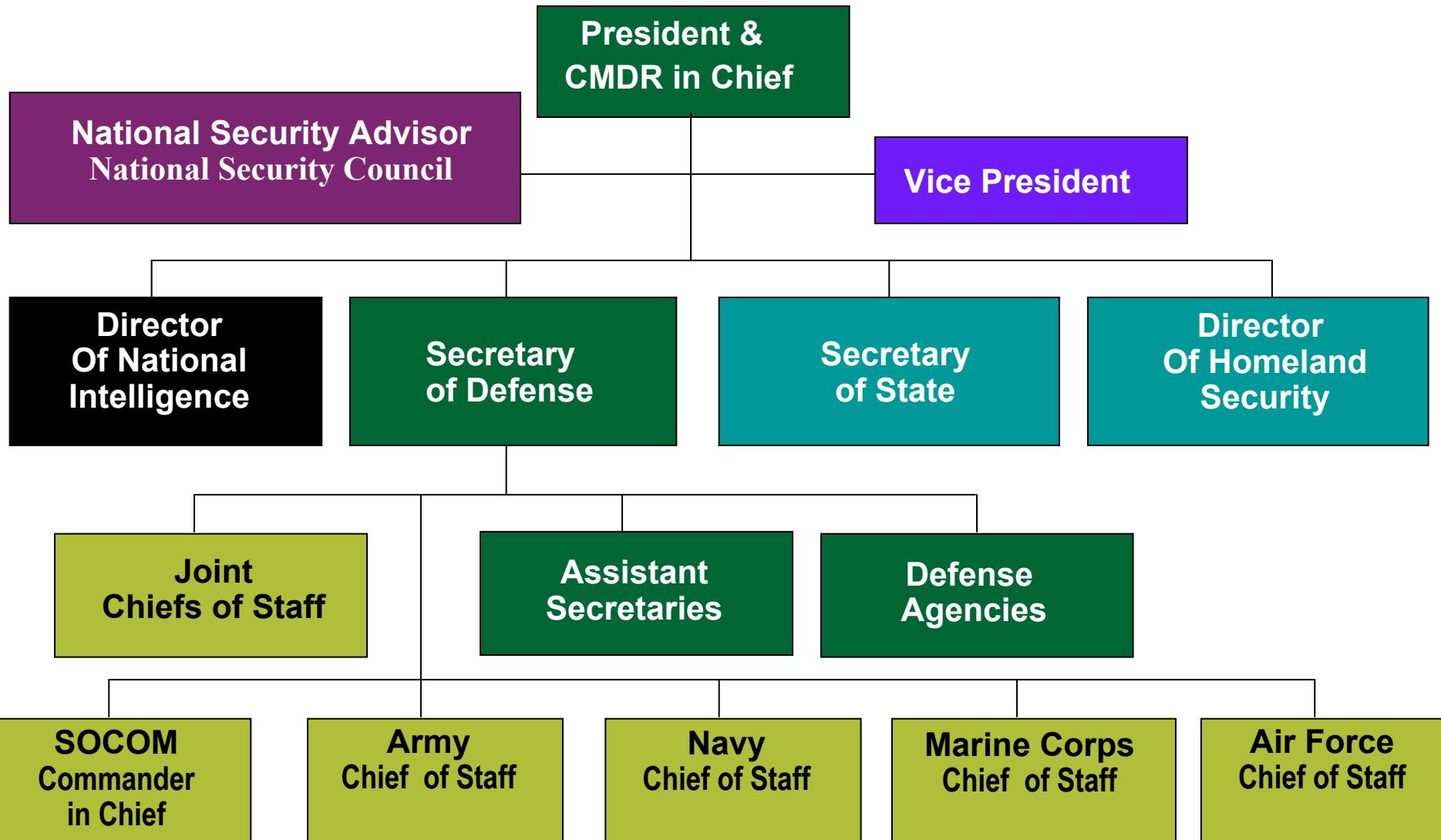


*President Dwight D. Eisenhower
Farewell Address to the People
January 17, 1961*

Military-Industrial Complex in Government



Basic U.S. Military Establishment



Department of Defense Headquarters



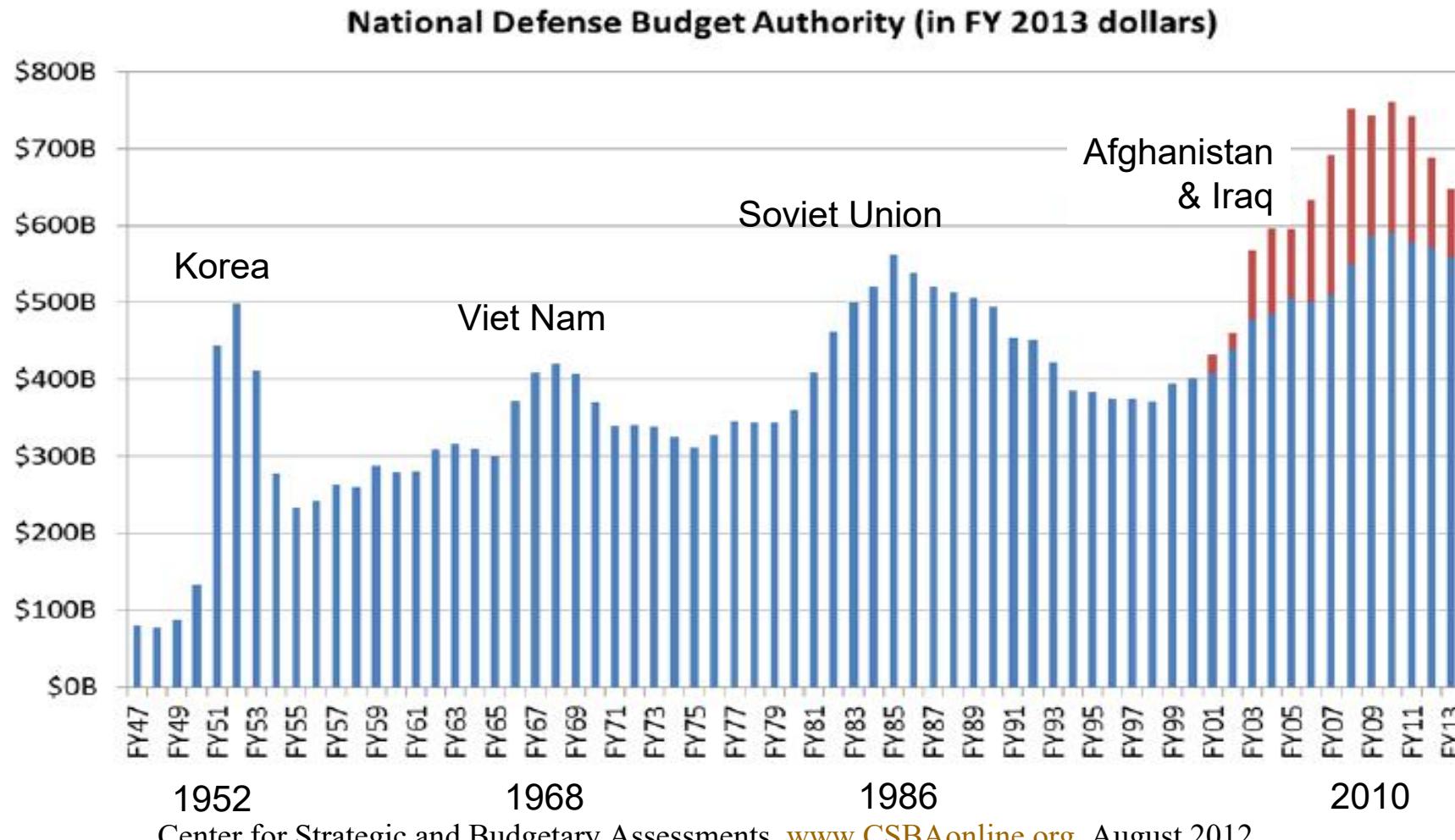
The Pentagon, Arlington, Virginia (across from Washington, DC)

New Department

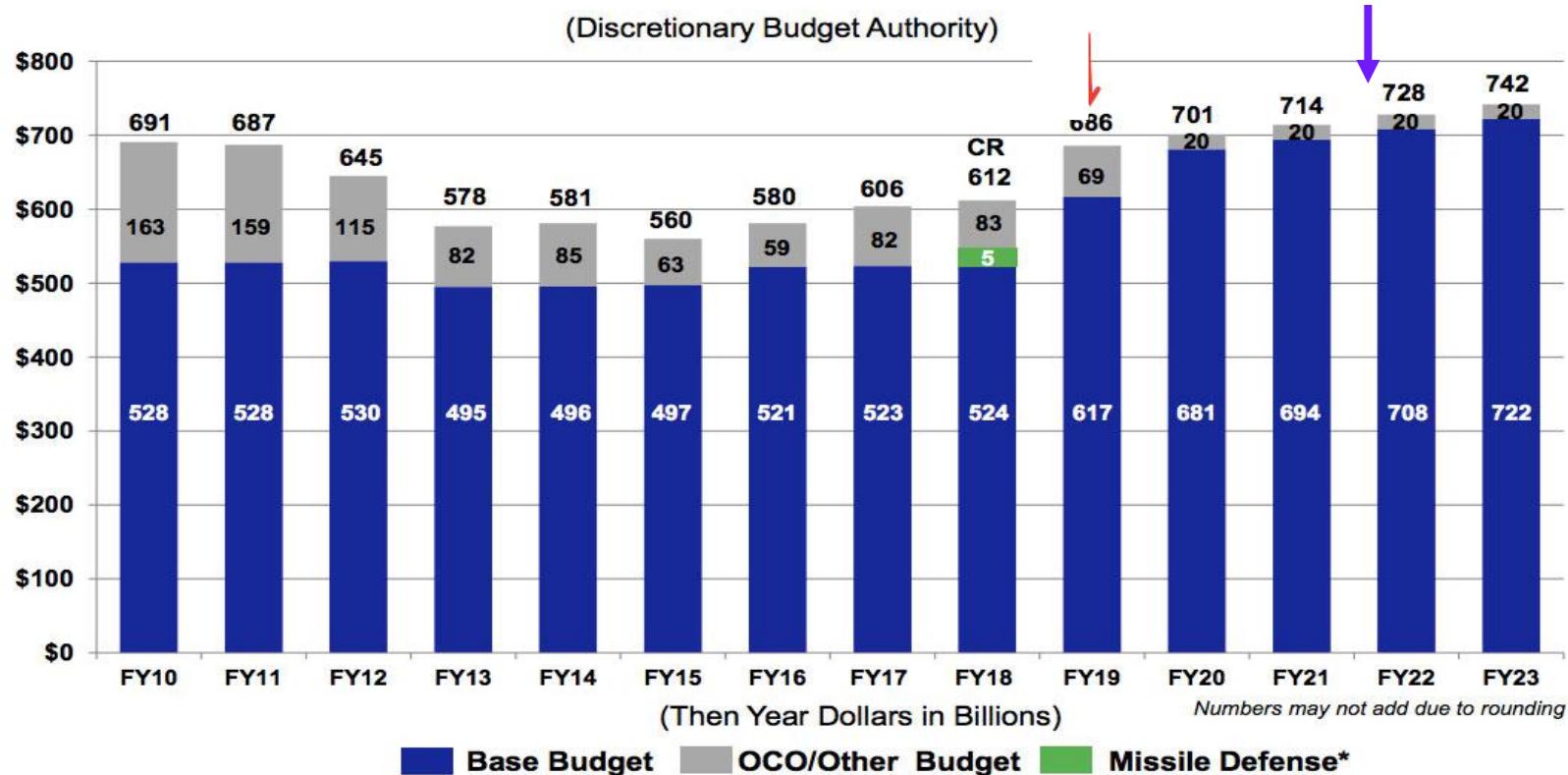


- Formed Post 9/11
- Official Mission
 - Protect the nation against further terrorist attacks. Component agencies will analyze threats and intelligence, guard our borders and airports, protect our critical infrastructure, and coordinate the response of our nation for future emergencies.
 - Protect the rights of American citizens. Enhance public services, such as natural disaster assistance and citizenship services, by dedicating offices to these important missions.
- R&D Priorities
 - Information and Infrastructure
 - Surveillance and Security

Long Term U.S. Defense Expenditures



Recent DoD Budgets



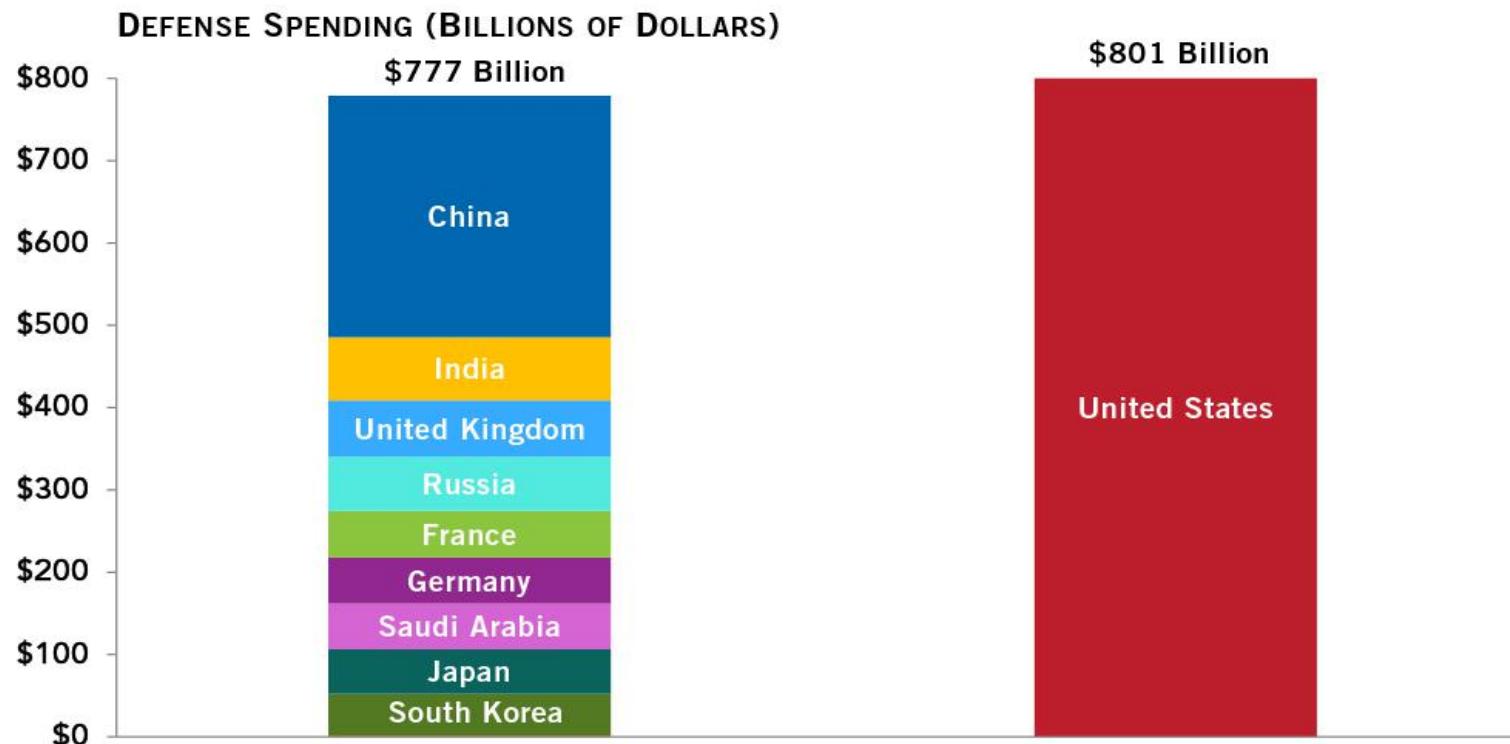
*Division B, P.L. 115-96, DoD Missile Defeat and Defense Enhancements Appropriations Act, 2018

Defense spending decreased during the Obama administration as a result of both presidential and congressional priorities. But in the Trump administration it increased again, with the budget for FY2020 over \$700 billion. The next several years' budgets are likely to continue increasing even under the Biden administration.

FY 2021 Spending Compared to Other Militaries



The United States spends more on defense than the next 9 countries combined



SOURCE: Stockholm International Peace Research Institute, *SIPRI Military Expenditure Database*, April 2022.

NOTES: Figures are in U.S. dollars converted from local currencies using market exchange rates. Data for the United States are for fiscal year 2021, which ran from October 1, 2020 through September 30, 2021. Data for the other countries are for calendar year 2021. The source for this chart uses a definition of defense spending that is more broad than budget function 050 and defense discretionary spending.

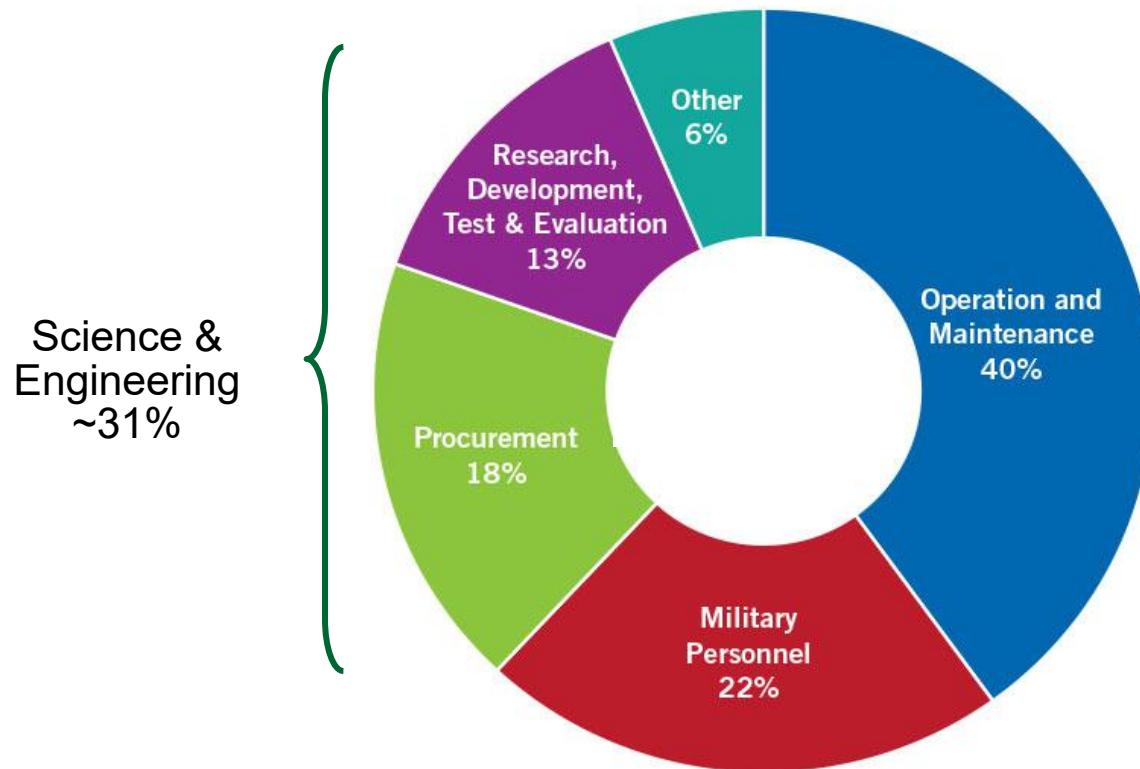
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Defense Budget Categories



Defense spending covers a wide range of activities



SOURCE: Office of Management and Budget, *Public Budget Database, Budget of the United States Government: Fiscal Year 2021*, February 2020.

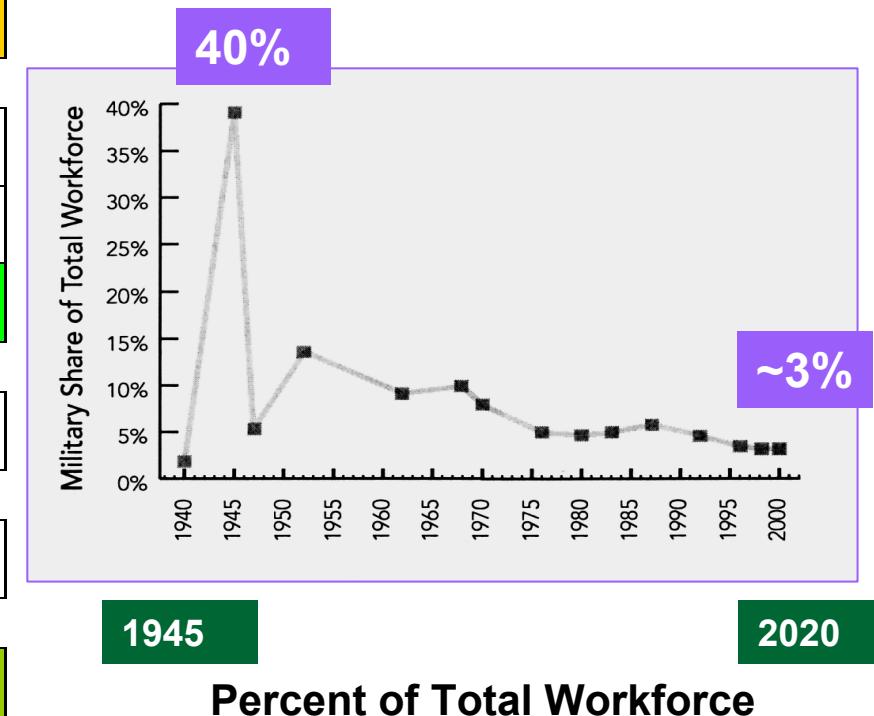
NOTES: Numbers may not sum to 100 percent due to rounding. The data presented above are for defense discretionary spending. Other includes atomic energy defense activities, FBI salaries and expenses, cybersecurity activities of the Department of Homeland Security, and smaller miscellaneous outlays.

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U.S. Defense Personnel (Approximate)

COMPONENT	NUMBER
Active Duty	1,300,000
Reserve Forces	800,000
Total Military Strength	2,100,000
DOD Civilian Personnel	~ 710,000
Defense Industry	~ 2,000,000
Total Defense Related	4,810,000



Comparison of Active Military (Approximate)

COUNTRY	NUMBER
Peoples Rep China	2,285,000
India	1,435,000
United States	1,300,000
Russia	866,000
North Korea	690,000
South Korea	640,000
Pakistan	617,000
Iran	545,000
Iran	545,000
Algeria	512,000
Indonesia	476,000
Egypt	468,000
Columbia	444,500
Vietnam	412,000

¹Data from <http://www.globalfirepower.com>

Leading U.S. Defense Companies

Defense Company	2018 Revenues (\$ Billion)	2021 Revenues (\$ Billion)	Main Products
Lockheed Martin Corp.	53.7	67.0	Aircraft, Simulators, Misc.
Boeing Company	101.1	62.3	Aircraft, Command Systems
Northrop Grumman Corp.	30.1	35.7	B2 Bomber, Electronics
General Dynamics Corp.	36.2	38.5	Submarines, Ships, Air Defense
Raytheon Company	27.1	64.4	Missiles, Electronics
Total	248.2	267.9	
SAIC	7.2	7.2	Science/Engineering Support

Apple	260.2	378.4	Electronic Devices & S/W
Amazon	232.9	469.8	Merchandise/Web Services

Top 20 Contractors get about 50% of total DOD procurements!

DOD's Current Policy Drivers

- Conventional Threats
 - Regional Conflicts
 - Rogue States
- Asymmetrical Threats
 - Worldwide Terrorist Movements
 - Local Insurgent Forces
- New Strategic Requirements
 - Stable and Friendly Governments
 - Force Composition (Women, LGT personnel)
 - Limited Size and Duration Missions
 - *Multi-Domain Operations*

Multi-Domain Operations refer to Land, Air, Maritime, Space, and Cyber. The idea is that conflict always exists as competition that can transition to extremely fast-paced and lethal engagement and then back to competition.

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 - Local Insurgent Forces
- New Strategic Requirements
 - Stable and Friendly Governments
 - Force Composition (Women, LGT personnel)
 - Limited Size and Duration Missions
 - *Multi-Domain Operations*
- New Tactical Requirements
 - Rapid Projection of Overwhelming Force
 - Minimal Casualties (Civilian and Military)
 - Attention to Cultural and Political Factors
 - Skilled Use of Social Media (Offense and Defense)
 - Benefits from Advanced Technologies

DOD's Technology Trusts

- Netcentric Warfare
- Defeating Asymmetric Threats
- Information Operations
- Missile and Satellite Defense
- Electronic Warfare
- Remote Targeting
- Unmanned & Autonomous Systems
 - Robots Land, Sea and Air
 - Artificial Intelligence
 - Lethal Autonomous Weapon Systems



Case 1 - Ethical Analysis: Overview of Warfare

Historical Perspective (Oversimplified)

- Military conflicts reach back to first recorded history
- Technology has historically supported military affairs
- Military imperatives have likewise driven technology

Moral Perspectives (Oversimplified)

- War is always an Immoral Undertaking
 - Killing is basically immoral - War is based on killing
 - War violates fundamental human rights
- War is sometimes a Moral Undertaking
 - Some principles and/or rights are worth fighting for to preserve
 - “If a person comes to kill you, it is permitted to kill him first”

A Reasonable Hypothesis

- “Just Wars” are possible -- both in purpose and in conduct

Ethical Analysis: “The Law of War (LoW)”

1. Military Necessity and Objective

There must be valid military needs, objectives and targets

2. Avoidance of Unnecessary Suffering

Military actions should encompass humanitarian concerns

3. Distinction and Discrimination

Combatants should be considered distinct from non-combatants

4. Proportionality

Loss of life and damage should be in line with valid military needs and objectives

Mission-specific “Rules of Engagement (ROE)” should generally adhere to LoW and interpret these in terms of the specific military situation at hand.

Ethical Analysis: Purpose of Just Wars

- National Defense – We fight back aggressively when attacked
- Projection of Power – We stay strong to exert positive influence and deter hostile actions by others
- Humanitarian Intervention – We act to prevent such crimes against humanity as genocide, ethnic cleansing, etc.
- Regime Change – We act to remove despots or to protect our military, our territory or our societal and economic interests
- Preventive or Preemptive Action – We act first to *prevent or preempt* enemy actions in wars involving WMDs, or wars with extra-national enemies such as terrorists

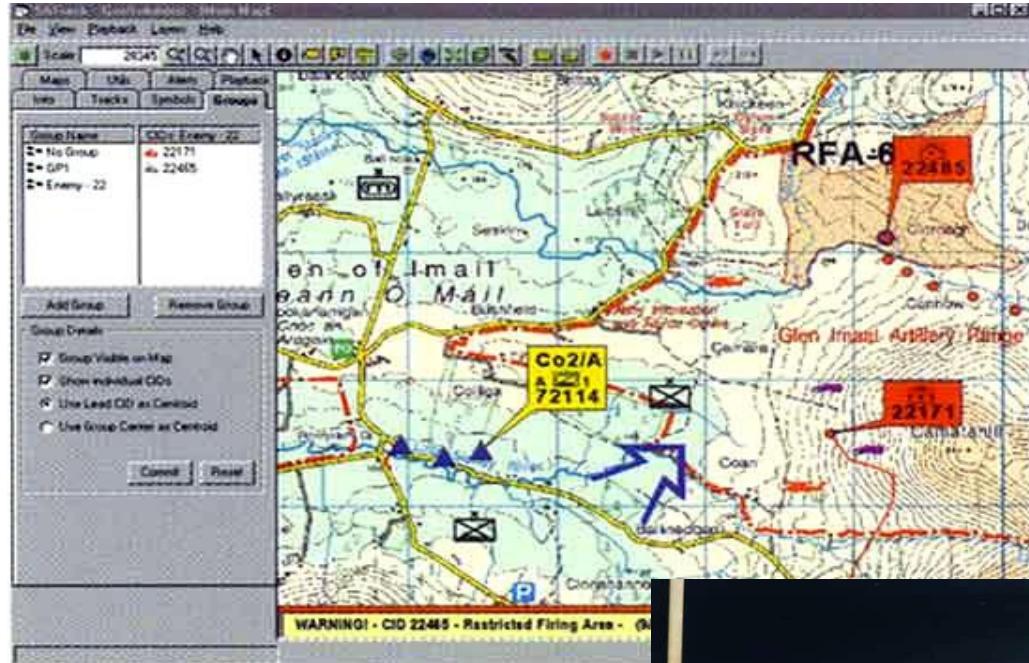
Ethical Analysis: Conduct of Just Wars

- Collateral Damage:
 - How critical is it?
 - How much is avoidable?
- Weapons of Mass Destruction
 - Who obtains?
 - What are the conditions for use?
- Terror and Suicide Bombing
 - Morally wrong
 - Or Just another weapon?
- Targeted Assassination
 - Justification...if any?
 - Rules, agencies and command structures?
- Treatment of Prisoners
 - Legal status of “stateless” terrorists?
 - Conditions of detention and trial?
 - Torture: Justification...if any?

Ethical Analysis: Consequences of Just Wars

- Occupation and Peacekeeping
 - Obligations
 - Objectives and Methodology
- Nation Building and Guidance
 - Cultural factors and acceptance
 - Who is in charge, and of what?
 - Does one system fit all?
- Counterterrorism and Counterinsurgency
 - Strategy and tactics
 - What is victory?
 - Are we in Orwell's continuous war of "1984"?

Netcentric Communications: Components



Unit Level Displays

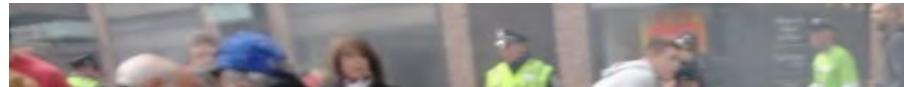


Field Radios

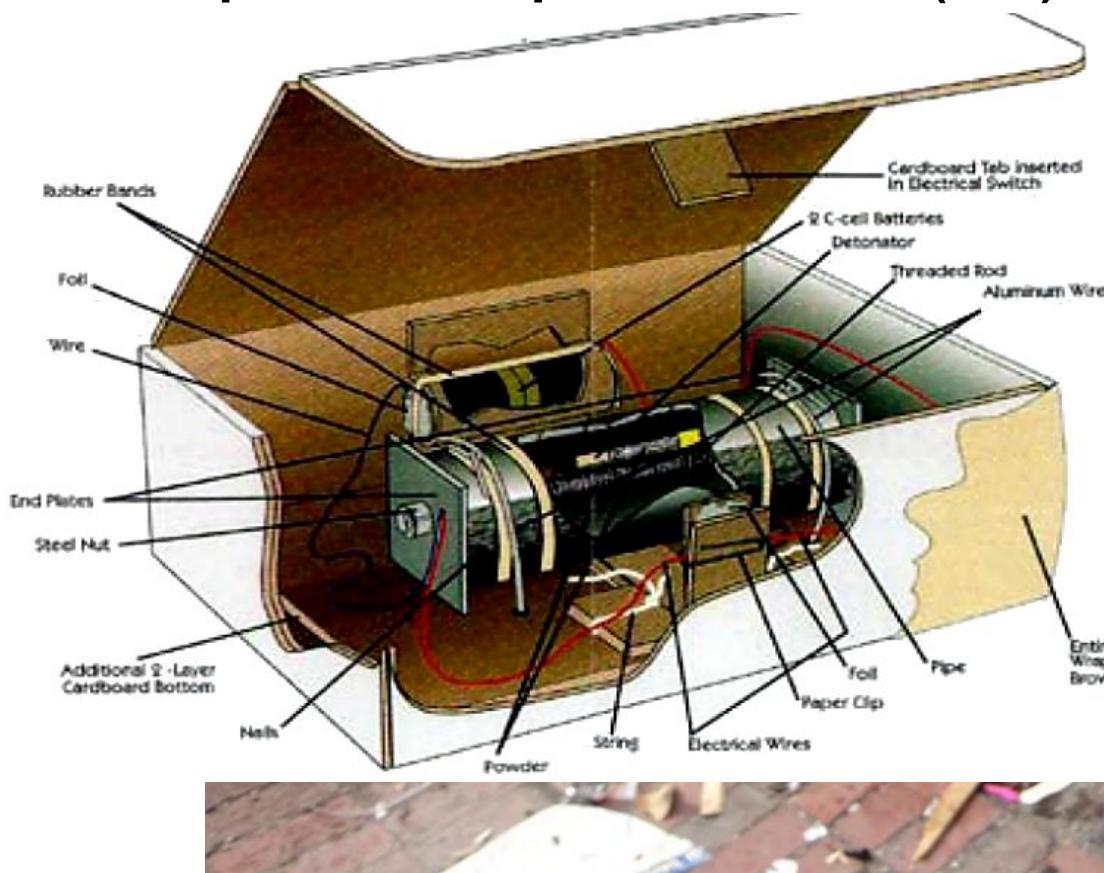


Satellite Links

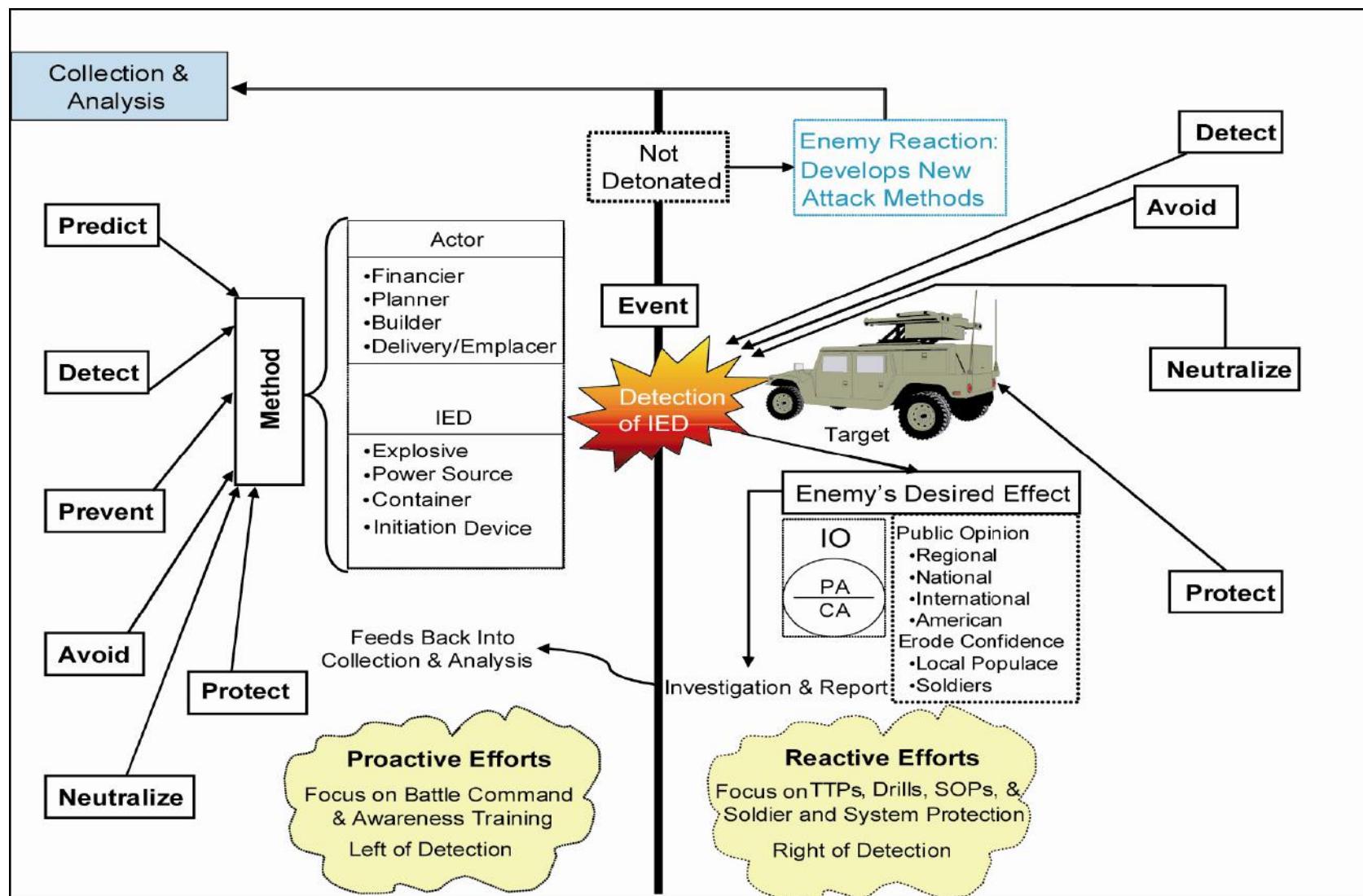
Asymmetric Warfare: Terror Weapons



Improvised Explosive Device (IED)



Asymmetric Counter: IED Defeat Framework



Information Operations

CORE CAPABILITIES

Psychological Operations
Military Deception
Operations Security

Electronic Warfare
Computer Network Operations

SUPPORTING CAPABILITIES

Information Assurance
Physical Security
Physical Attack
Counterintelligence
Combat Camera

RELATED CAPABILITIES

Public Affairs
Civil-Military Operations
Defense Support to Public Diplomacy

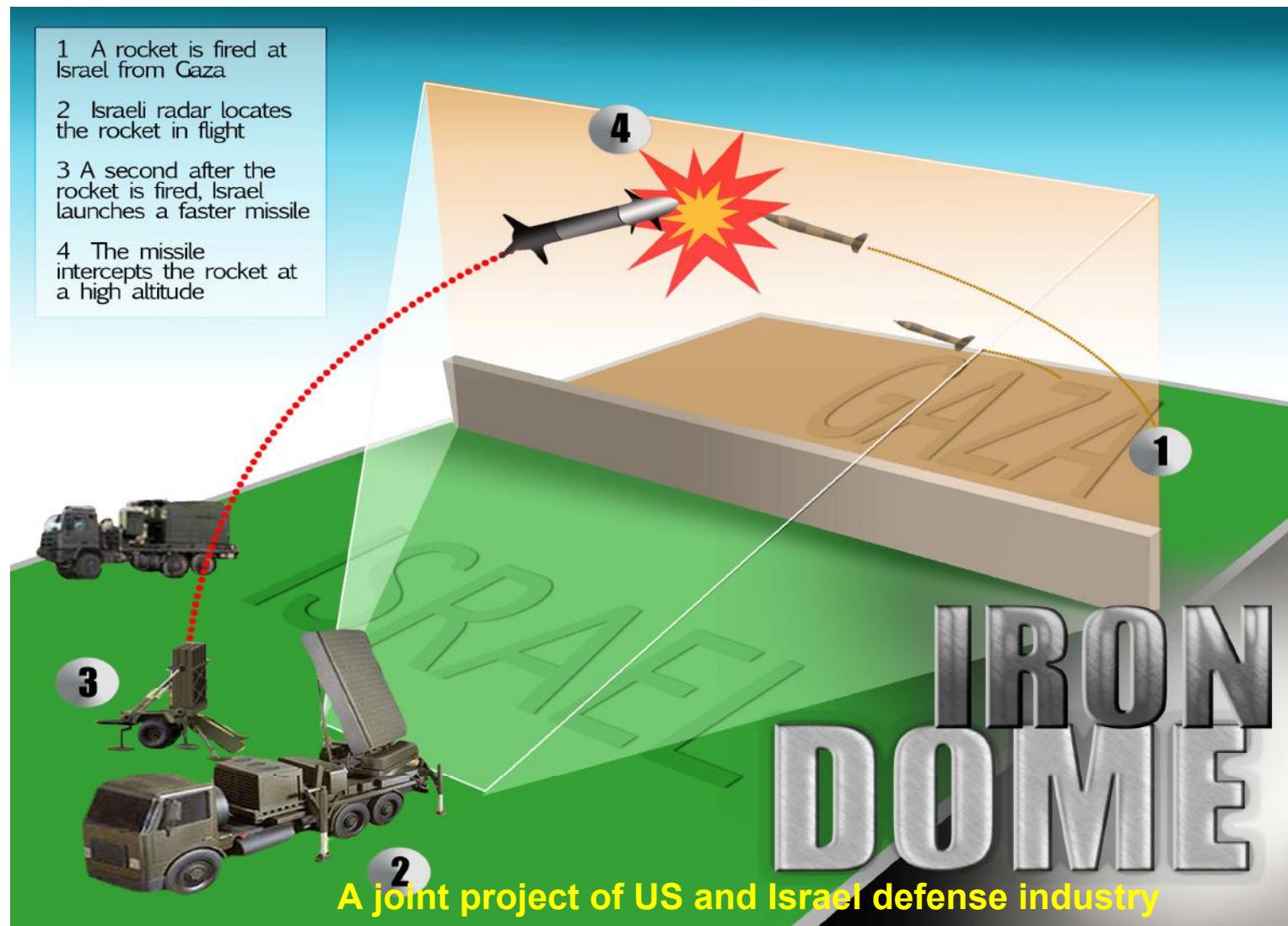
INFORMATION OPERATIONS DEFINITION

“The integrated employment of the core capabilities of electronic warfare, computer network operations, psychological operations, military deception, and operations security, in concert with specified supporting and related capabilities, to influence, disrupt, corrupt or usurp adversarial human and automated decision-making, while protecting our own.”

Information Operations: Social Media



Missile Defense: Short Range Protection



Electronic Warfare: A New Battlefield



Photo: U.S. Army Graphic.

“The Electronic Warfare Planning and Management Tool (EWPMT) will allow for greater control and enhancement of electronic warfare capabilities. The tool will tightly integrate EW as a form of *non-kinetic fires* with existing *kinetic capabilities* that will enable the Army to achieve *spectrum dominance* through an *effects-based joint operations plan*.”

Remote Targeting: Afghanistan Origins (2001)

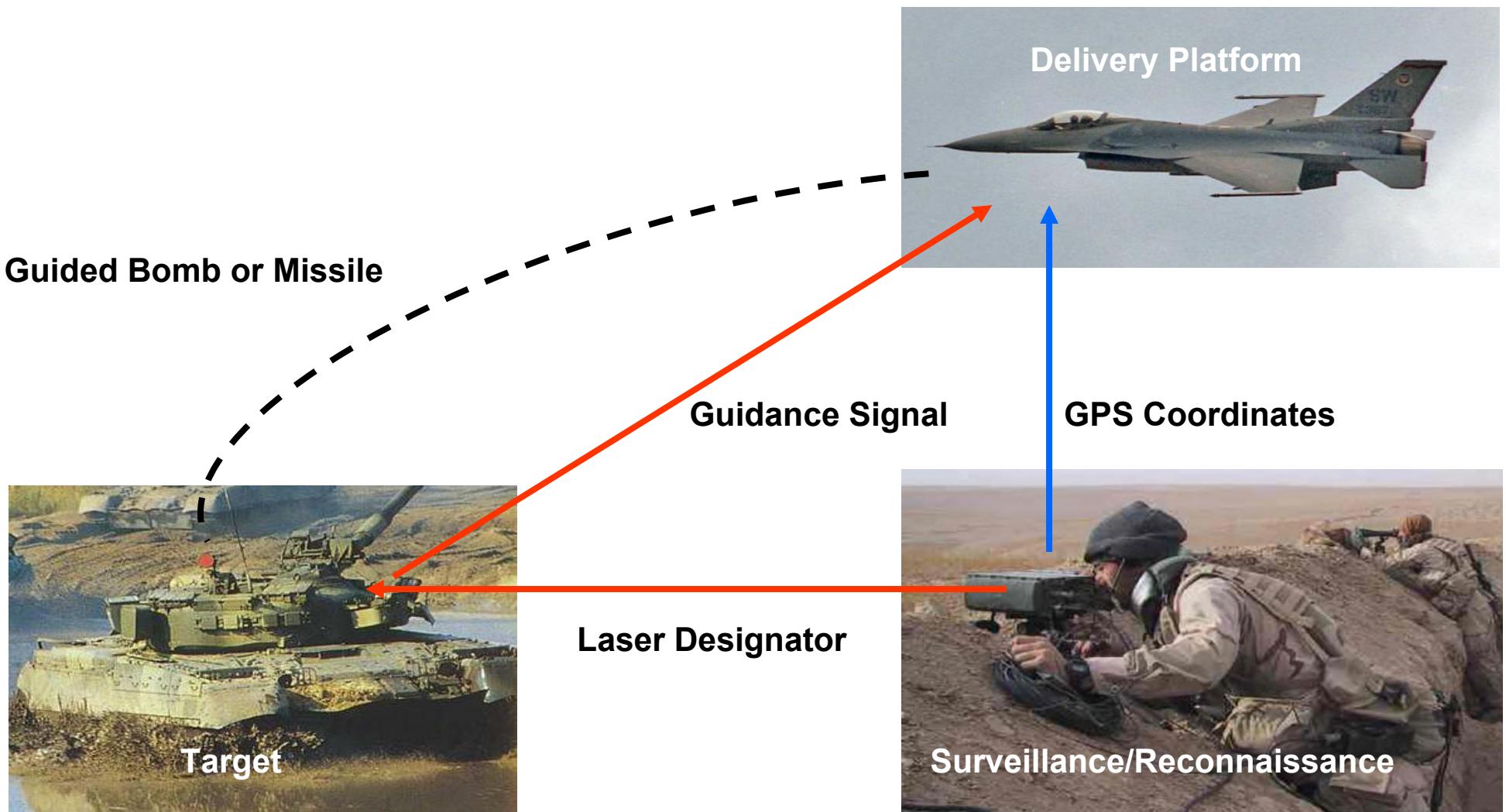


General Abdul Rashid Dostum



US Special Forces A-Team

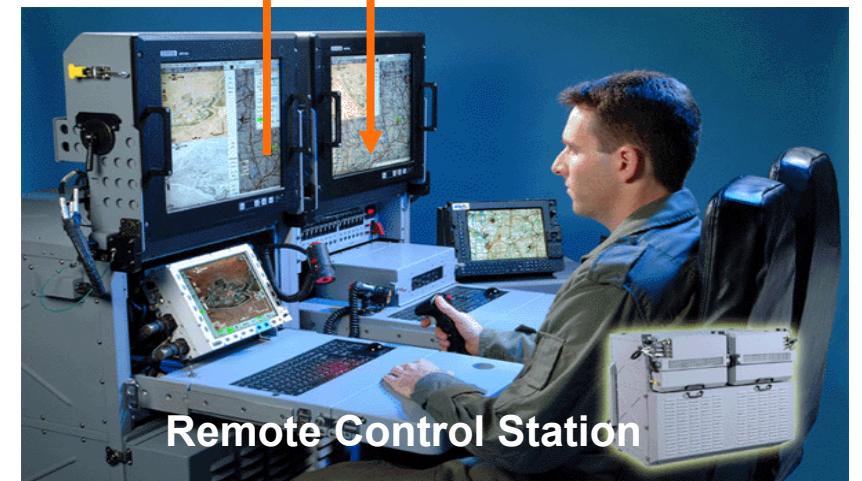
Remote Targeting: Afghanistan Application



Remote Targeting: Scaling Up



**Firing Commands
Control Signals**



Remote Targeting: Public Reaction



Time Magazine, May 7, 2013

Remote Targeting: Varying Opinions

12A NEWS

OPINION

TODAY'S DEBATE NATIONAL SECURITY

Our view

Rein in the drones, but keep them flying

For all the success and domestic popularity of America's drone warfare against terrorists abroad, the program carries some major downsides: It kills innocent civilians. It radicalizes survivors against the United States. It enrages politicians in countries such as Pakistan who bristle at the encroachment on their sovereignty. And it raises uncomfortable moral and legal questions, particularly about the targeting of U.S. citizens.

Yet, as President Obama argued convincingly in a speech Thursday, all the other options are worse. Rely on local governments to root out terrorists? Not realistic. Send in U.S. troops?

Obama strikes a sound balance

ground troops? Even more risky. Employ conventional airstrikes? Far more dangerous to civilians. Ignore the threat? Ridiculous.

The conclusion is obvious: As long as terrorists continue to plot attacks against America, drones remain an important part of the fight.

Obama's unusual openness about the controversial assassination program was part of his larger attempt to reframe the war on terror he inherited from George W. Bush. To the dismay of supporters who thought he would ground the drones, Obama has overseen nearly 400 attacks to Bush's 50. The victims, the administration

als, including one who repeatedly shouted him down for what she said was a betrayal of American values, and from conservatives such as Sen. Saxby Chambliss, R-Ga., who said the speech "will be viewed by terrorists as a victory."

In our view, the president's rules for using drones represent a practical, effective middle ground: No strikes when a target can be captured. Targets must "pose a continuing and imminent threat" to the American people. And there must be "near certainty" that a strike will not kill or injure civilians.

Though the president did not explicitly say so, the administration is shifting at least some of the program from the CIA — which by law cannot admit or describe drone attacks — to the Pentagon, which can act more

A Navy drone launches off the nuclear-powered aircraft carrier USS George H.W. Bush off the coast of Virginia. It will help develop other unmanned, carrier-based aircraft.



STEVE HELBER/AP

Opposing view

Drones drain USA's moral might

Michael Shank

Armed drones, at first blush, are a boon to America's military toolkit, as President Obama reinforced in his counterterrorism speech on Thursday. Drones, in the short run at least, could mean fewer U.S. troops deployed and fewer American lives lost.

Unsurprisingly, the appeal is mounting for unmanned killing

World faces rapid spread of killer robots

machines that know no national boundary, need no permit for deployment and go unnoticed by enemies. More than 75 nations have remotely piloted aircraft. Drones are merely the latest in military innovation; all countries will want one shortly.

Another innovation, happening simultaneously, is more sinister. We are disposing of past precedent and throwing conventions to the curb with our willingness to kill Americans outside the court of law with little prosecutorial evidence, our secret White House kill list, and our erroneous belief that strikes are strategic.

Signature strikes rely on ambiguous behavioral patterns of un-

with technology or jurisprudence and more to do with something softer: America's moral might and the goodwill it garners globally. Having worked in Pakistan in the early 2000s, when public opinion was more pro-American, I've witnessed over the past decade the deterioration of goodwill toward America, exhausted through our use of drones.

Tabling serious sovereignty concerns, America is killing humans it will never know or look in the eye — all from a joystick in Texas. We have no skin in the game. There is no white flag for adversaries, no opportunity for surrender. The once-regarded American beacon of justice is now as inhumane and robotic as our drones.

There are more effective ways of winning hearts and minds and creating livelihoods worth living, not sacrificing. We must innovate our way toward that task and broaden our diplomatic tools because if the trajectory of arms flow is any indication, we face a rapid proliferation of killer robots.

Easier means of engaging in conflict and violating sovereignty lead to more wars that will pull in America.

And when the rules governing the international system break down or are ignored, all hell breaks loose. Meaning more troops on the ground and more American lives lost.

USA TODAY
FRIDAY, MAY 24, 2013

Remote Targeting: Operator Stress



Good Kill is the fictional story of a former F-16 pilot, currently assigned as a drone operator, who is severely psychologically disturbed by the ethical ambiguity of remote killing.

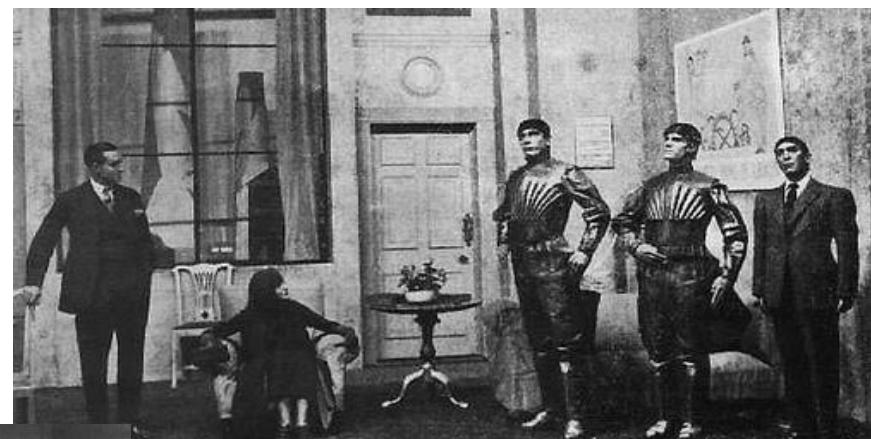
But stress and PTSD are in fact serious problems affecting real-life drone operators.

<http://www.bing.com/images/>

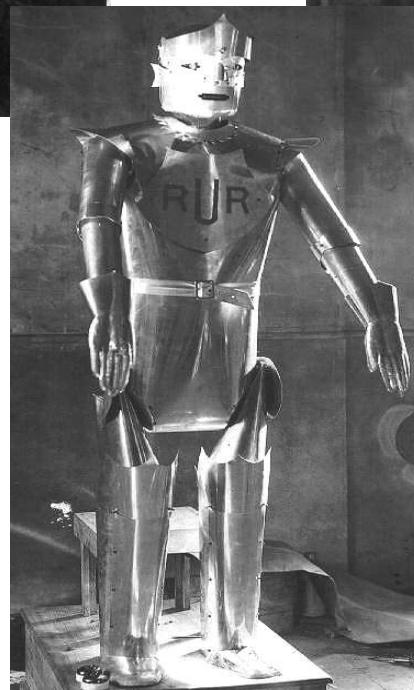
Robotic Systems: Fictional Humanoids



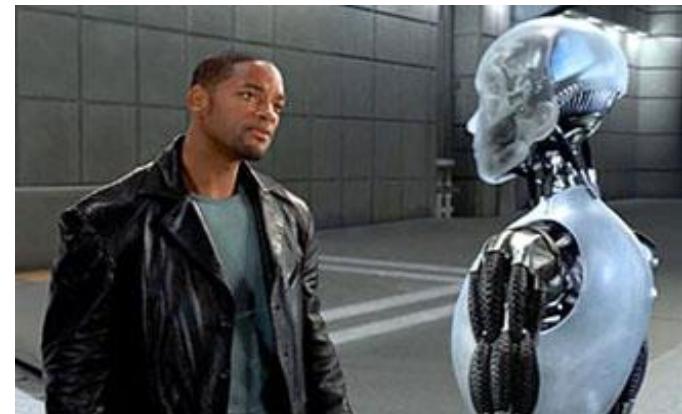
1847 "Folktale –The Golem of Prague"



1921 "Movie–RUR"



1920 Play "R.U.R."
(Rossum's Universal Robots)
by Karel Capek



1950 Book – “I Robot” by Isaac Asimov -
2008 Movie – Will Smith, James Cromwell

Early Humanoid Robot



~1495, Leonardo da Vinci designed a “mechanical knight”

Humanoid Robots Today



DARPA envisions humanoid robots able to carry out a broad variety of tasks, such as demolition or rescue, in environments too dangerous for humans,

Humanoid Robots Today

UCLA Professor Dennis Hong, Ph.D.



The UCLA Robotics & Mechanisms Laboratory directed by acclaimed Professor Dennis Hong is a leader in R&D of multi-purpose humanoid (and other) robots.

Humanoid Robots Today

UCLA Professor Dennis Hong, Ph.D.



THOR-RD: Tactical Hazardous Operations Robot – Rapid Deployment



THOR-RD (Tactical Hazardous Operations Robot – Rapid Deployment) is a disaster relief humanoid robot that is a modified version of THOR-OP2. It is fully actuated with 31 degrees of freedom controlled by modular position control actuators, and uses IMUs, F/T sensors, LIDARS, webcams, and other various sensors to conduct both locomotion and manipulation. At 150 cm and 54 kg, THOR-RD is about the same size as a person, and has the functionality to match. It participated in the DARPA Robotics Challenge Finals in 2015 in Pomona, California, USA, while it also became a world champion in robot soccer competition Robocup 2015 held at Hefei, China.

CHARLI: Cognitive Humanoid Autonomous Robot with Learning Intelligence



CHARLI is the United States' first full-size autonomous humanoid robot. Its mechanical design has allowed experimentation into the effects of different mechanical configurations, mostly in the legs, on the performance of bipedal walking and balancing. CHARLI is capable of walking in all directions as well as turning, kicking, and performing gestures and simple upper body manipulation tasks. A variety of hands and grippers have been experimented with for various objects or goals. [More...](#)

Ground Robots Today: Unmanned Vehicles



Activmedia P2DX Small Robots

Ocean Robots Today: Unmanned Vehicles



SAAB Unmanned Underwater Vehicle

US Navy Unmanned Underwater Vehicle



Air Robots Today: Unmanned Aerial Vehicles (UAVs)



Air Robots Today: Unmanned Aerial Vehicles (UAVs)

Aerovironment Raven



Boeing X-45 UCAV



Carnegie Mellon
Helicopter UAV

Air to Ground
Missile
Honeywell
Ducted Fan UAV



Air Robots Today: Small UAVs



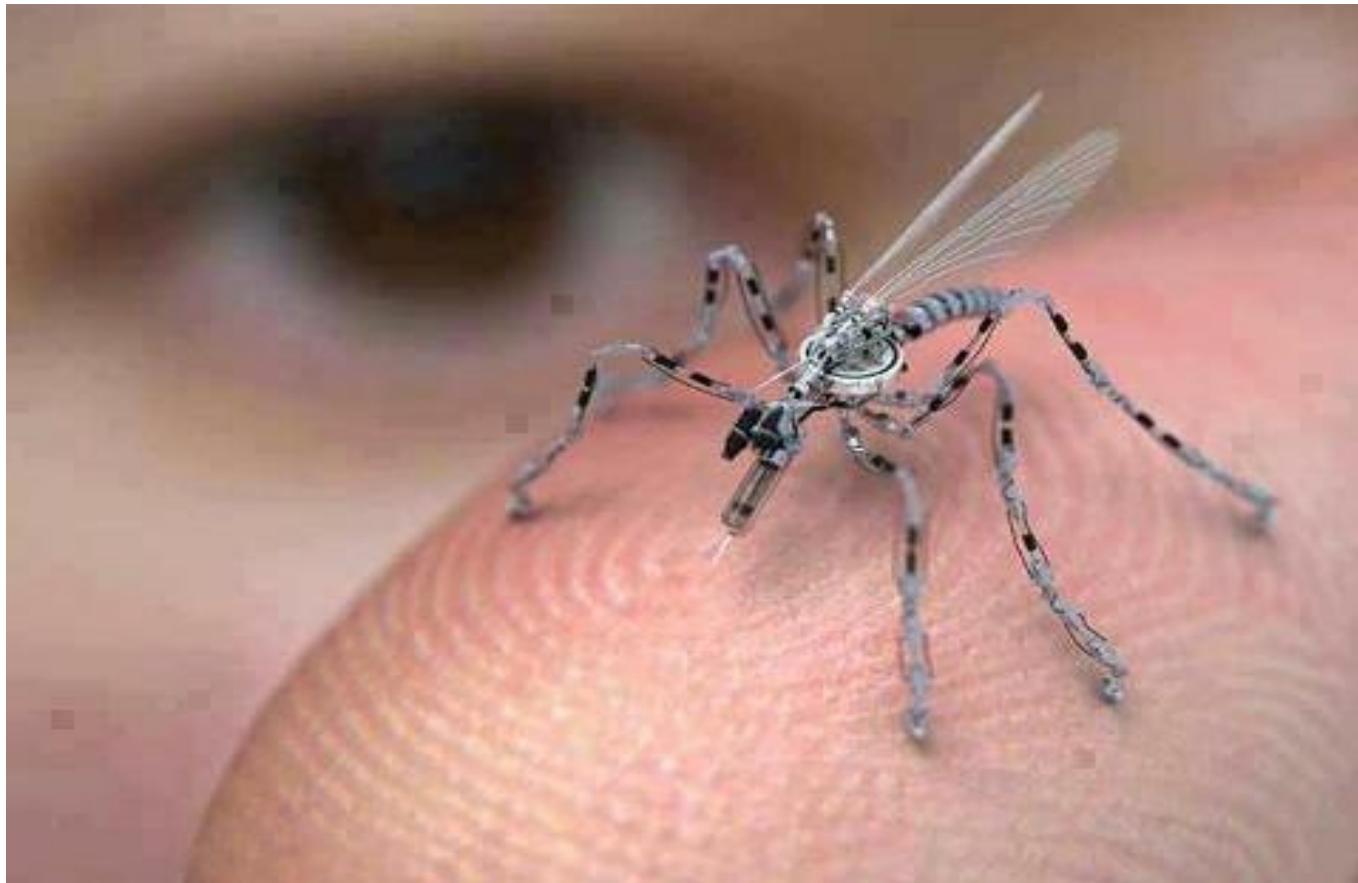
Black Hornet Nano produced by Norwegian company Prox Dynamics flies like a helicopter and was used operationally by British Forces in Afghanistan

Air Robots Tomorrow: VERY Small UAVs



Nano Hummingbird developed for DARPA by local company Aeroenvironment weighs less than AA battery and can fly observation missions up to 8 minutes

Air Robots Tomorrow: VERY VERY Small UAVs



The Insect Drone is only a concept today, but the technology is not impossible

Air Robots Today: Drone Dragnet



Air Robots Tomorrow: Drone Swarms



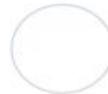
Military analysts have suggested that 1000s of low cost drones could defeat a city, and the US Air Force is currently experimenting with releasing swarms from aircraft.

Tomorrow's Dangers: Unintended Consequences

The Unstoppable Spread of Lethal Drones

The United States hastened the proliferation of a weapon that diminishes its relative power.

12:29 PM ET



Conor Friedersdorf
Staff writer at *The Atlantic*



Conor Friedersdorf maintains that the US promotion of deadly drone technology has given our adversaries access to new and very lethal asymmetrical weapons.

Tomorrow Has Arrived: Ukraine Drones Stop Russia



Ukraine drones include the relatively low cost Bayraktar drone from Turkey

Tomorrow Has Arrived: Ukraine Drones Stop Russia



Ukraine drones include Switchblade from the United States, a so-called Kamikaze drone

Next Step: Autonomous Lethal Weapon Systems (LAWS)

Should Pentagon Let Robots Kill Humans? Maybe

By Sydney J. Freedberg Jr., Monday, July 10, 2017 4:00 AM



Imagine battles unfolding faster than the human mind can handle, with artificial intelligences choosing their tactics and targets largely on their own. The former four-star commander in Afghanistan, John Allen, and an artificial intelligence entrepreneur, Amir Husain, have teamed up to develop a concept for what they call "hyperwar," rolled out in the July issue...

LAWS in Current Practice: Loitering Munitions



Kargu-2 Loitering Munition

Loitering munitions are recognized as a type of LAWS, as are anti-personnel mines.

Ethics of Autonomous Lethal Weapon Systems

- Isaac Asimov postulated 3 basic laws of robotics in his 1950 science fiction novel “I, Robot:”
 1. **A Robot shall never carry out any action which will cause any injury to any human being.**
 2. **A Robot shall always obey a human being's orders, provided the first law is not violated.**
 3. **A Robot shall always try to protect itself, provided the first two laws are not violated.**

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 3. **A Robot shall always try to protect itself, provided the first two laws are not violated.**
- A later Science Fiction writer R. Daneel Olivan integrated and expanded the Asimov laws to:
 1. **A Robot may not harm humanity or, by inaction, allow humanity to come to harm.**

It is obvious the military today does not accept the Asimov laws, but is there a path to developing “killer robots” that adheres to accepted ethical standards for war?

Ethics of Intelligent Lethal Weapons

As military robots act with more intelligence, developers ask:

- How much autonomy should be given to robotic weapons?
- What are the *ethical and moral values* that should be programmed into intelligent and lethal robotic systems?
- What shared assumptions and values are necessary for the productive co-existence of humans and intelligent lethal robots?

And the overriding questions are:

**Should we be developing Lethal Autonomous Weapons at all?
If so, under what conditions?**

LAWS: Some Scientists/Engineers Say “No”

Autonomous Weapons: An Open Letter from AI and Robotics Researchers

Autonomous weapons select and engage targets without human intervention. They might include, for example, armed quadcopters that can search for and eliminate people meeting certain pre-defined criteria, but do not include cruise missiles or remotely piloted drones for which humans make all targeting decisions. Artificial Intelligence (AI) technology has reached a point where the deployment of such systems is — practically if not legally — feasible within years, not decades, and the stakes are high: autonomous weapons have been described as the third revolution in warfare, after gunpowder and nuclear arms.

Many arguments have been made for and against autonomous weapons, for example that replacing human soldiers by machines is good by reducing casualties for the owner but bad by thereby lowering the threshold for going to battle. The key question for humanity today is whether to start a global AI arms race or to prevent it from starting. If any major military power pushes ahead with AI weapon development, a global arms race is virtually inevitable, and the endpoint of this technological trajectory is obvious: autonomous weapons will become the Kalashnikovs of tomorrow. Unlike nuclear weapons, they require no costly or hard-to-obtain raw materials, so they will become ubiquitous and cheap for all significant military powers to mass-produce. It will only be a matter of time until they appear on the black market and in the hands of terrorists, dictators wishing to better control their populace, warlords wishing to perpetrate ethnic cleansing, etc. Autonomous weapons are ideal for tasks such as assassinations, destabilizing nations, subduing populations and selectively killing a particular ethnic group. We therefore believe that a military AI arms race would not be beneficial for humanity. There are many ways in which AI can make battlefields safer for humans, especially civilians, without creating new tools for killing people.

Just as most chemists and biologists have no interest in building chemical or biological weapons, most AI researchers have no interest in building AI weapons — and do not want others to tarnish

“Starting a military AI arms race is a bad idea, and should be prevented by a ban of offensive autonomous weapons beyond meaningful human control.”

Open Letter signed by over 100 scientists and engineers, July, 2015

goal of the field should be to do so. Starting a military AI arms race is a bad idea, and should be prevented by a ban on offensive autonomous weapons beyond meaningful human control.

LAWS: Other Scientists/Engineers Say “OK, but....”



We Should Not Ban ‘Killer Robots,’ and Here’s Why

By Evan Ackerman

Posted 29 Jul 2015 | 2:25 GMT



What we really need...is a way of making autonomous armed robots ethical, because we're not going to be able to prevent them from existing. In fact, the most significant assumption that this letter makes is that armed autonomous robots are inherently more likely to cause unintended destruction and death than armed autonomous humans are. This may or may not be the case right now, and

“What we really need...is a way of making autonomous armed robots ethical, because we're not going to be able to prevent them from existing.”

target have a weapon? Is that weapon pointed at you? Has the weapon been fired? Have you been hit? These are all things that a robot can determine using any number of sensors that currently exist....

Military AI: DoD Offers High Level Ethical Guidelines

The Defense Department's new principles call for people to "exercise appropriate levels of judgment and care" when deploying and using AI systems, such as systems that scan aerial imagery to look for targets.



SUSAN WALSH Associated Press

THE DEFENSE Department's new principles call for people to "exercise appropriate levels of judgment and care" when deploying AI systems. Above, Defense Secretary Mark Esper talks at a news conference in 2019.

U.S. military adopts new ethics principles for AI

Move comes as the Pentagon aims to boost its battlefield use of artificial intelligence systems.

ASSOCIATED PRESS

The U.S. military is adopting new ethics principles as it prepares to accelerate its use of artificial intelligence technology on the battlefield.

The Defense Department's new principles call for people to "exercise appropriate levels of judgment and care" when deploying and using AI systems, such as systems that scan aerial imagery to look for targets.

They also say decisions made by automated systems should be "traceable."

the Pentagon's Joint Artificial Intelligence Center.

The Pentagon's push to speed up its AI capabilities has fueled a fight between tech companies over a \$10-billion cloud computing contract known as the Joint Enterprise Defense Infrastructure, or JEDI.

Microsoft Corp. won the contract in October but hasn't been able to work on the 10-year project because Amazon.com Inc. sued the Pentagon, arguing that President Trump's antipathy toward Amazon and its chief executive, Jeff Bezos, hurt Amazon's chances of winning the bid.

A 2012 military directive requires humans to be in control of automated weapons but doesn't address broader uses of AI. The new U.S. principles are meant to

"Tech adapts. Tech evolves," he said.

The Pentagon hit a roadblock in its AI efforts in 2018

by the Defense Innovation Board, a group led by former Google CEO Eric Schmidt.

Although the Pentagon acknowledged that AI "raises new ethical ambiguities and risks," the new principles fall short of stronger restrictions favored by arms control advocates.

"I worry that the principles are a bit of an ethics-washing project," said Lucy Suchman, an anthropologist who studies the role of AI in warfare. "The word 'appropriate' is open to a lot of interpretations."

Shanahan said the principles are intentionally broad to avoid handcuffing the U.S. military with specific restrictions that could become outdated.

"Tech adapts. Tech evolves," he said.

The Pentagon hit a roadblock in its AI efforts in 2018

Shanahan said the principles are helping to regain support from the tech industry, where "there was a thirst for having this discussion."

"Sometimes I think the angst is a little hyped, but we do have people who have serious concerns about working with the Department of Defense," he said.

Shanahan said the guidance also helps secure America's technological advantage as China and Russia pursue military AI with little attention paid to ethical concerns.

University of Richmond law professor Rebecca Crootof said that adopting principles is a good first step, but that the military will need to show it can evaluate the huge data troves used by AI systems, as well as their cybersecurity risks.

Crootof said she also

Los Angeles Times, February 25, 2020

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Defense Innovation Board (DIB) is More Specific

- **Responsible.** Human beings should exercise appropriate levels of judgment and remain responsible for the development, deployment, use, and outcomes of DoD AI systems.
- **Equitable.** DoD should take deliberate steps to avoid unintended bias in the development and deployment of combat or non-combat AI systems that would inadvertently cause harm to persons.
- **Traceable.** DoD's AI engineering discipline should be sufficiently advanced such that technical experts possess an appropriate understanding of the technology, development processes, and operational methods of its AI systems, including transparent and auditable methodologies, data sources, and design procedure and documentation.
- **Reliable.** DoD AI systems should have an explicit, well-defined domain of use, and the safety, security, and robustness of such systems should be tested and assured across their entire life cycle within that domain of use.
- **Governable.** DoD AI systems should be designed and engineered to fulfill their intended function while possessing the ability to detect and avoid unintended harm or disruption, and for human or automated disengagement or deactivation of deployed systems that demonstrate unintended escalatory or other behavior.

DIB (2019) "AI Principles: Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense"

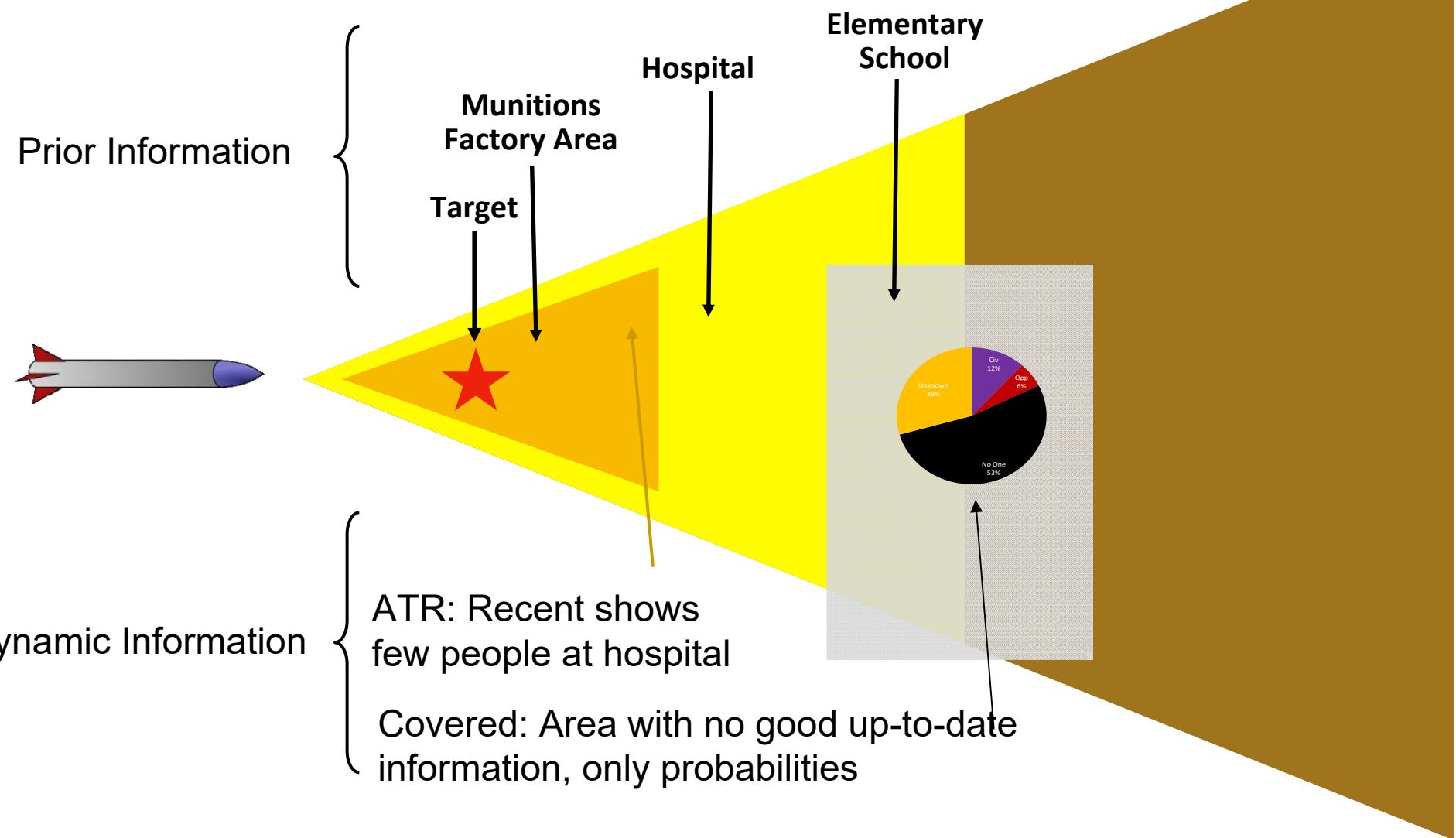
DIB and The Law of War

The US Department of Defense says:

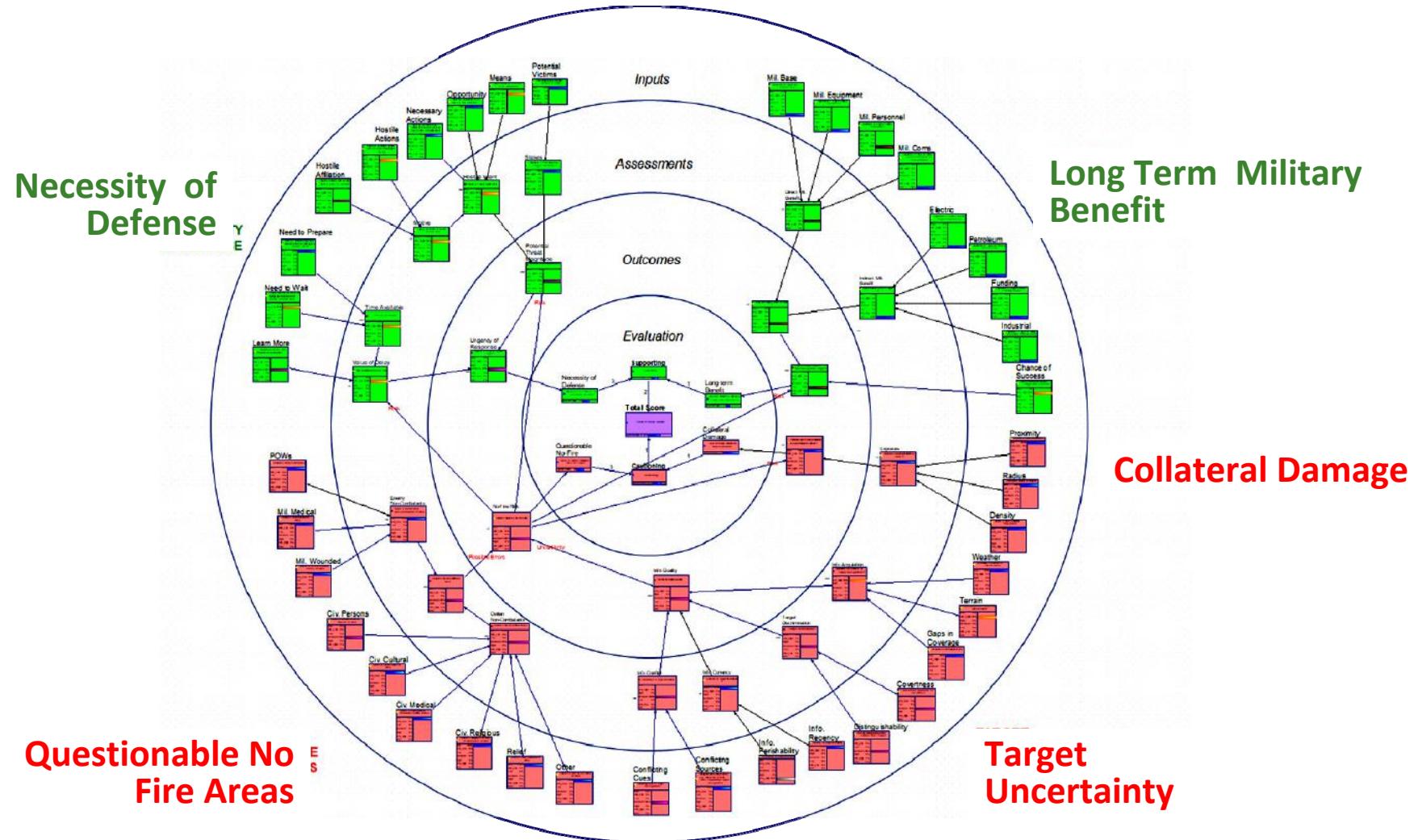
- “The Law of War is a body of international law specially adapted to war.
- For the United States, this body of law includes treaties the United States has accepted, such as the 1949 Geneva Conventions, and customary international law, which results from the general and consistent practice of States done out of a sense of legal obligation.
- ***Existing Law of War rules can apply when new technologies, such as AI, are used in armed conflict.***
- ***Existing Law of War rules can regulate uses of AI in armed conflict. As DoD has explained in the context of cyber operations.***
- ***The Law of War affirmatively anticipates technological innovation and contemplates that its existing rules will apply to such innovation, including cyber operations.***
- ***Law of War rules may apply to new technologies because the rules often are not framed in terms of specific technological means.”***

DIB (2019) “AI Principles: Recommendations on the Ethical Use of Artificial Intelligence by the Department of Defense”

Sample LAWS Scenario

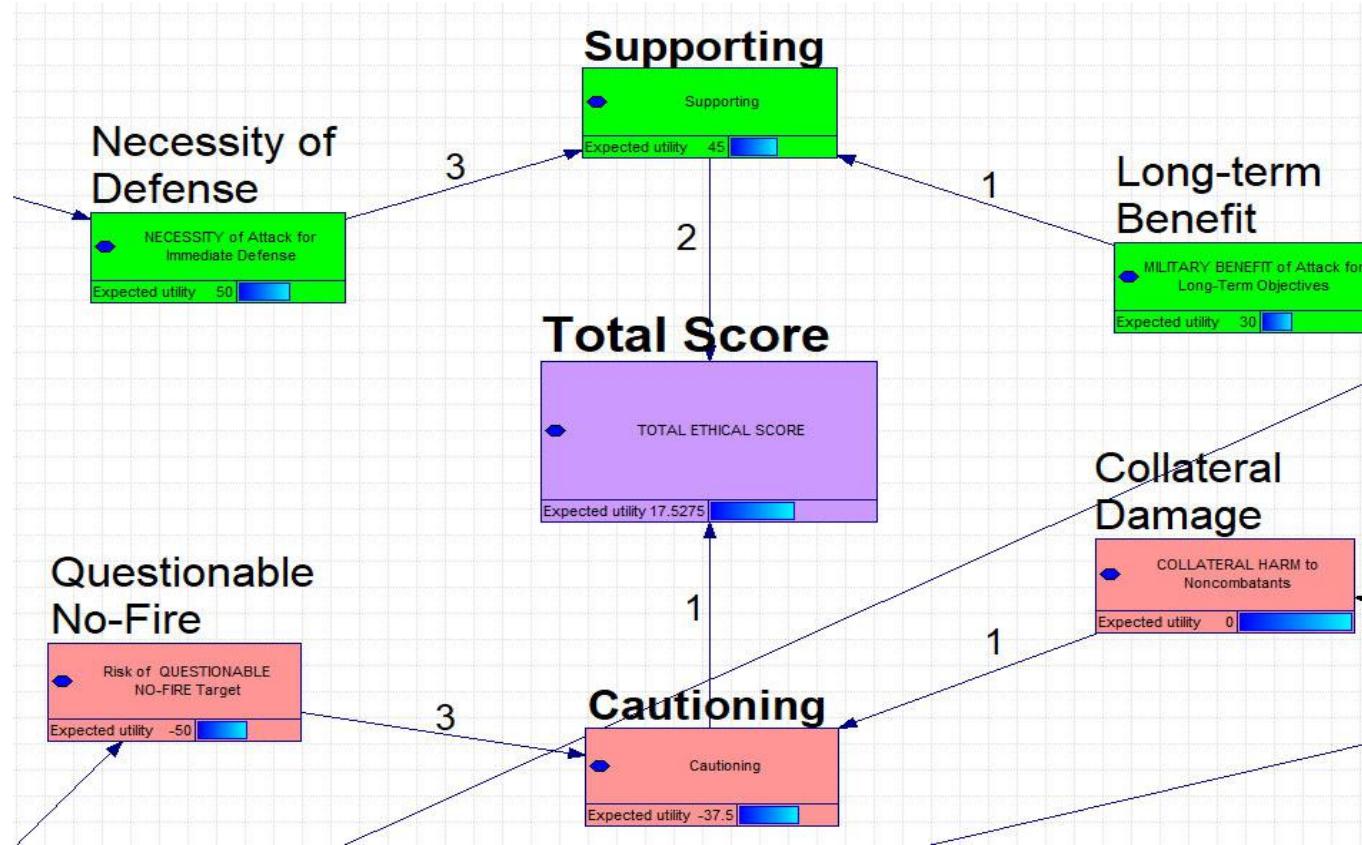


Bayesian “Strike/No Strike” Decision Model



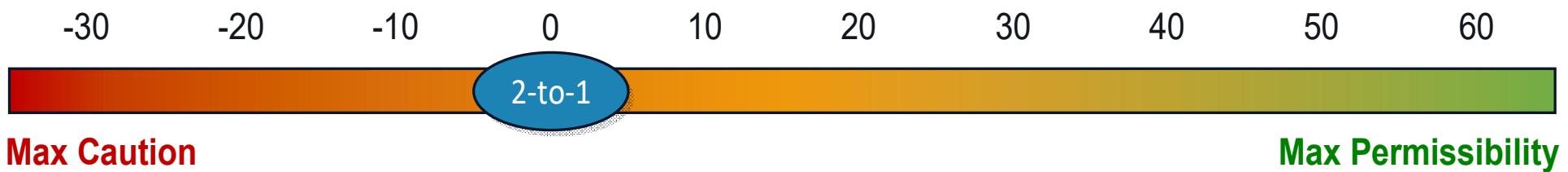
The Bayesian model includes a broad variety of ethical and military factors

Critical “Total Ethical Score” Decision Factors



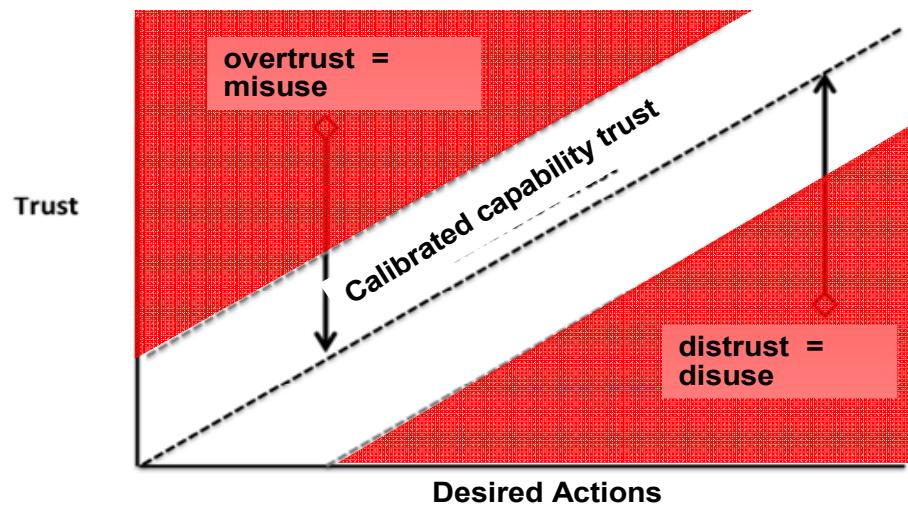
The Bayesian model incorporates the Law of War rules in its decision reasoning

Ethical Score Range

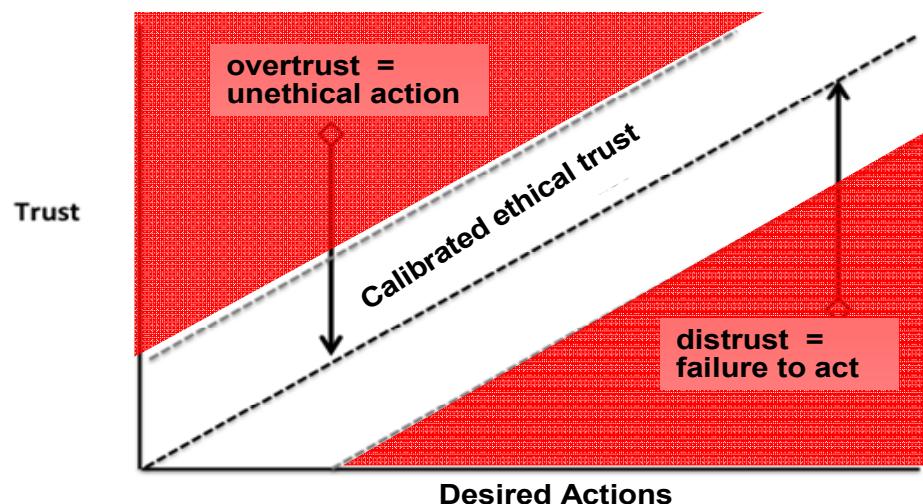


In this example the ratio of Permissibility to Caution has been set at 2-to-1, so the Ethical Score for a strike will be within the range of a scale that goes from **Maximum Caution of -33** to **Maximum Permissibility of 67**

A Key Issue is Calibrated Ethical Trust



Calibrated ‘Capability trust’ avoids *misuse* from *overtrust* and *disuse* from *distrust* of automation capabilities.



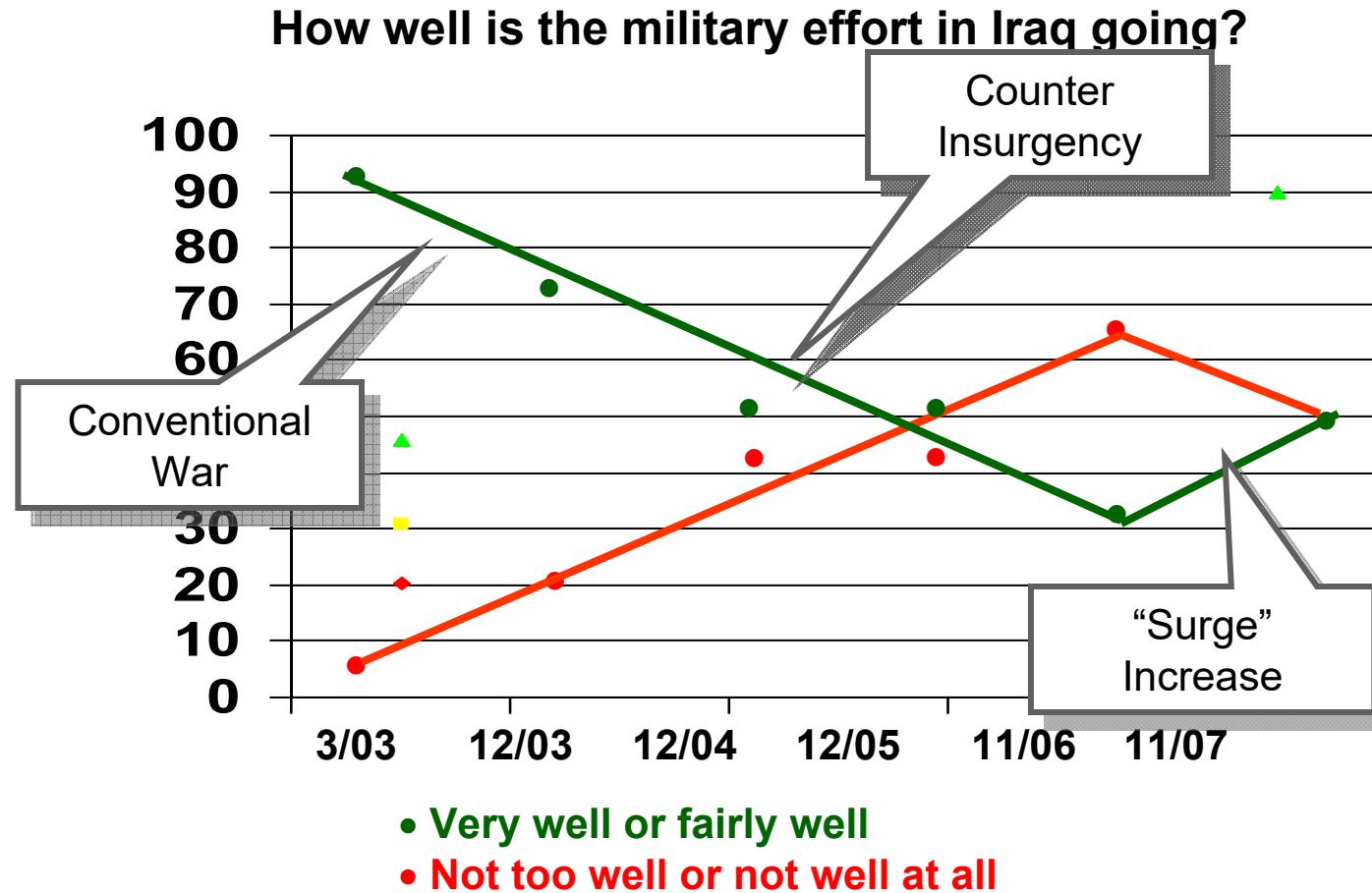
Calibrated ‘Ethical trust’ is analogous:
If the operator of an autonomous lethal robot ***overtrusts***, the robot may act unethically; if the operator ***distrusts***, the robot may not be assigned a mission at all.

Current research is examining how to achieve a match between modeled and human values

Ethical LAWS: Summary

- Advances in technology point to a future in which autonomous systems will become capable of executing many military mission assignments, including mission assignments involving lethal force.
- It is essential that such lethal autonomous weapons perform ethically at all times because the consequences of autonomous system failures in the ethical realm can be severe both in terms of mission accomplishment and of international reaction.
- However, in the foreseeable future all lethal autonomous weapon systems will continue to require a human operator to provide supervisory control. As a result, a critical question will be:
Can the operator trust the LAWS to take ethical actions as intended?
- If the operator *undertrusts* the LAWS' ethical functioning, he or she will not be making full use of its autonomous capabilities; if the operator *overtrusts* the LAWS' ethics, the autonomy may be placed in an ethical situation beyond its reasoning capabilities and act unethically, putting the operator and agency in violation of the Laws of War (LOW), Humanitarian Principles, and/or mission-specific Rules of Engagement (ROE).
- Valid ethical trust calibration will help avoid potential disasters, and will increase military users' willingness to collaborate with lethal autonomous technology.

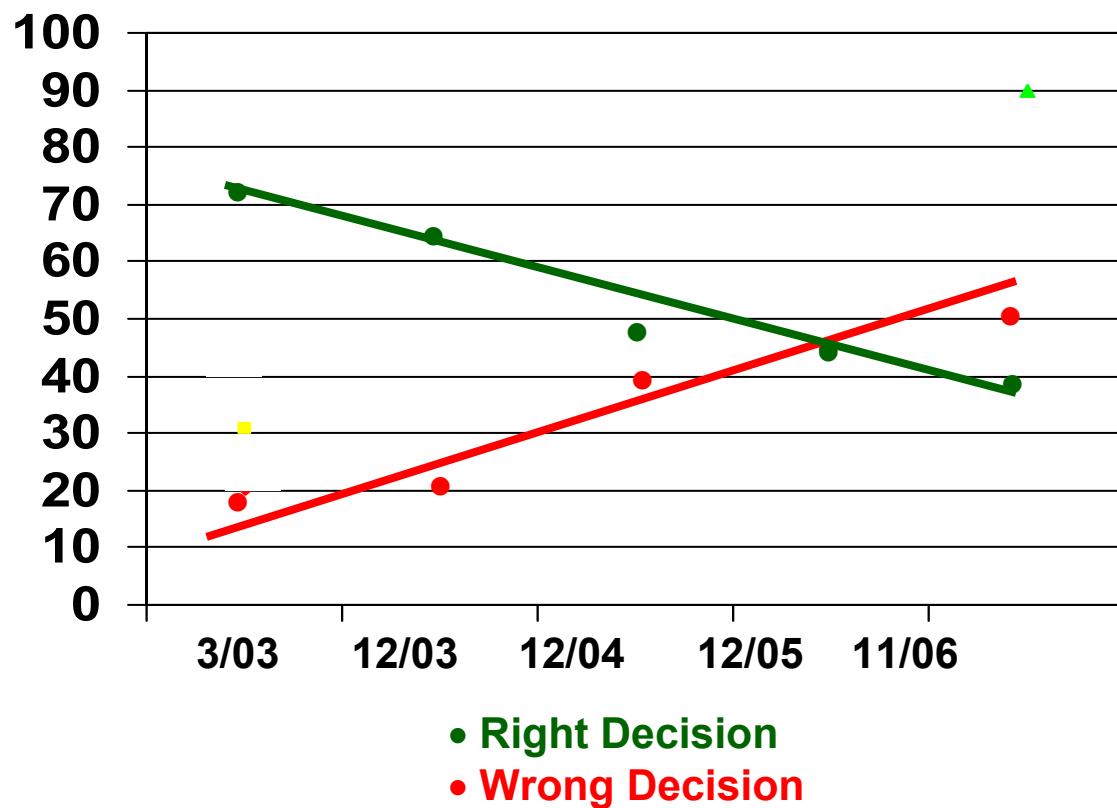
Case 3: Reactions to War Follow Outcomes....



Pew Research Center for the People and Press Survey; www.pollingreport.com

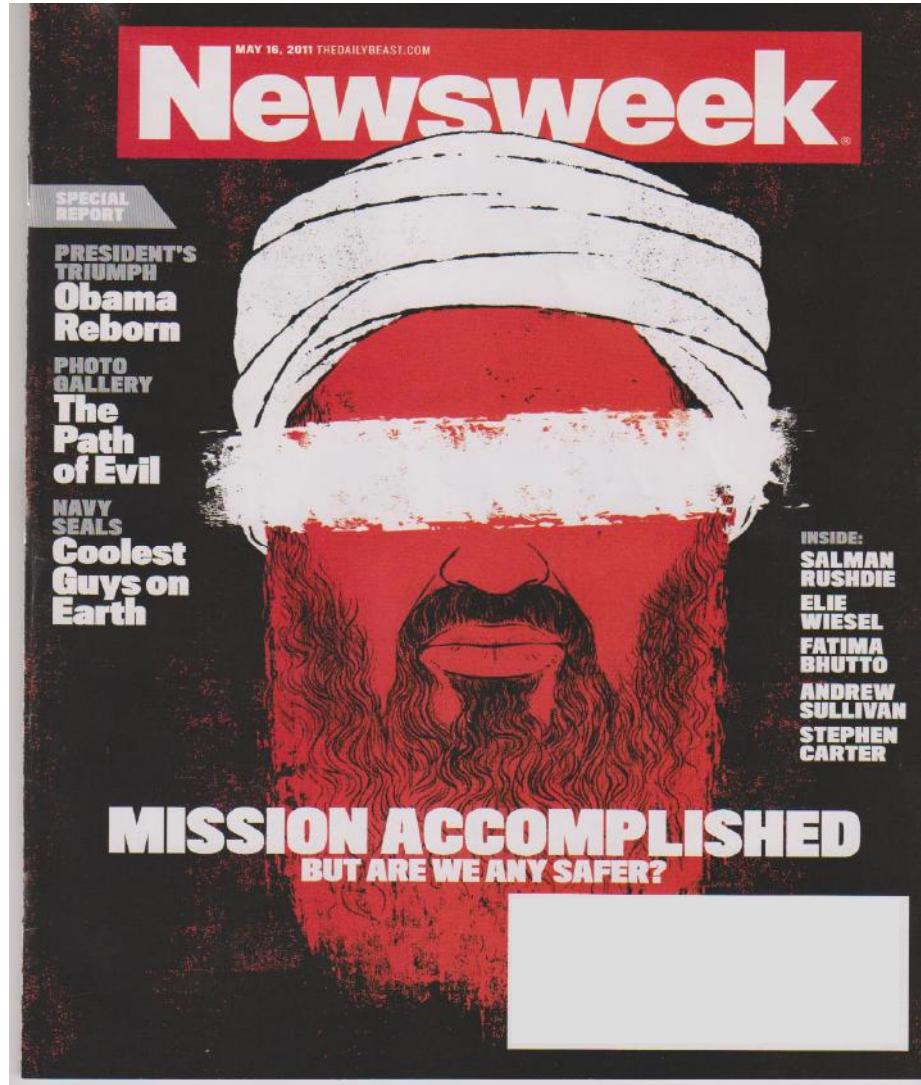
....and Often Reevaluate Previous Decisions...

Did we make the right decision or the wrong decision in using military force against Iraq?



Pew Research Center for the People and Press Survey; www.pollingreport.com

...But One Event Can Tip the Balance of Opinion



Final Thoughts: A Continuing Conversation

“History teaches us that it is not possible to fight a war without making tragic decisions along the way. The time to figure out whether one is willing to accept these considerable moral costs is before making the decision to fight. President Obama’s firm and unapologetic speech represents a willingness to shoulder the moral burden that war implies; in this he follows in his predecessors’ footsteps. ***This realism about the cost of war is all to the good, but the conversation about right and wrong methods must continue.***”

Stephen L. Carter
Professor of Law, Yale University
Newsweek, May 16, 2011

Final Thoughts: A Personal Decision

Participation in military technology is an individual decision.

Final Thoughts: A Personal Decision

The image shows a screenshot of a CBS News website. At the top, there is a navigation bar with the CBS News logo, followed by links for NEWS, THE OSCARS, SHOWS, LIVE, and a search icon. The main headline reads: "Microsoft workers protest use of HoloLens headsets for war: 'We did not sign up to develop weapons'". Below the headline, the date "FEBRUARY 23, 2019 / 7:43 AM / AP" is displayed, along with social media sharing icons for Facebook, Twitter, and LinkedIn.

Microsoft workers protest use of HoloLens headsets for war: "We did not sign up to develop weapons"

FEBRUARY 23, 2019 / 7:43 AM / AP

f t linkedin

A group of Microsoft workers is demanding the company cancel a contract supplying the U.S. Army with HoloLens headsets that they say would turn real-world battlefields into a video game. Microsoft's head-mounted HoloLens displays use augmented reality, which means viewers can see virtual imagery superimposed over the scenery in front of them.

A letter signed by more than 50 Microsoft employees Friday and circulated on an internal messaging board said the technology could help soldiers spot -- and kill -- adversaries on the battlefield. They say they "refuse to create technology for warfare and oppression."

Some engineers prefer not to participate -- individually or as employees.

Final Thoughts: A Personal Decision

Participation in military technology is an individual decision..

But you do not want to decide while believing that the military establishment is ethically unthinking or unconcerned – that is typically not the case.

Final Thoughts: Coherent Views

From a Soldier

"We can never spend too much time thinking about our profession. There is no better way to develop the sure knowledge and confidence required of our calling than a disciplined, focused commitment to a personal course of reading and study."

*General Eric Shinseki (USA Ret)
Former U.S. Army Chief of Staff*

From a President and a Soldier

"Only an alert and knowledgeable citizenry can compel the proper meshing of the huge industrial and military machinery of defense with our peaceful methods and goals, so that security and liberty may prosper together ."

*President Dwight D. Eisenhower
Farewell Address to the People
January 17, 1961*

Further Study for a Fuller Perspective

- Books – For example:
 - The Killer Angels, Michael Shaara, 1974
 - The Face of Battle, John Keegan, 1976
 - The Greatest Generation, Tom Brokaw, 1998
 - Fields of Fire, James Webb, 2001
- Movies – For example:
 - From Here to Eternity, Fred Zinnemann, 1953
 - Apocalypse Now, Francis Ford Coppola, 1979
 - Platoon, Oliver Stone, 1986
 - Full Metal Jacket, Stanley Kubrick, 1987
 - Saving Private Ryan, Steven Spielberg, 1998
 - Band of Brothers, David Frankel and Tom Hanks, 2001
 - Black Hawk Down, Ridley Scott, 2001
 - Flags of Our Fathers, Clint Eastwood, 2006
 - The Hurt Locker, Kathryn Bigelow, 2008
 - The Gatekeepers, Dror Moreh, 2012
 - Good Kill, Andrew Niccol, 2014
 - Eye in the Sky, Gavin Hood, 2015
 - 12 Strong, Nicolai Fuglsig, 2018