



THE PATUXENT PARTNERSHIP
LIKE NO OTHER CONNECTION

The Patuxent Partnership WEBINAR



AI at War

Captain George Galdorisi, USN (ret)

Captain Dr. Sam Tangredi, USN (ret)

14 July 2021

George Galdorisi

George Galdorisi is Director of Strategic Assessments and Technical Futures for the Naval Information Warfare Center Pacific. Prior to joining NIWC Pacific, he completed a thirty-year career as a naval aviator, culminating in 14 years of consecutive experience as executive officer, commanding officer, commodore, and chief of staff. In his spare time he enjoys writing, especially speculative fiction about the future of warfare. He is the author of fifteen books, including four consecutive *New York Times* bestsellers.

Sam Tangredi

Sam is currently the Naval War College's Leidos Chair of Future Warfare Studies, Professor of National, Naval And Maritime Strategy and a few other grandiose titles that he forgets. In addition to AI, he is interested in talking with anyone who would like to contribute to two pending collaborative projects: lessons of the Maritime Strategy for today's era of great power conflict, and hypersonics—so what's new?

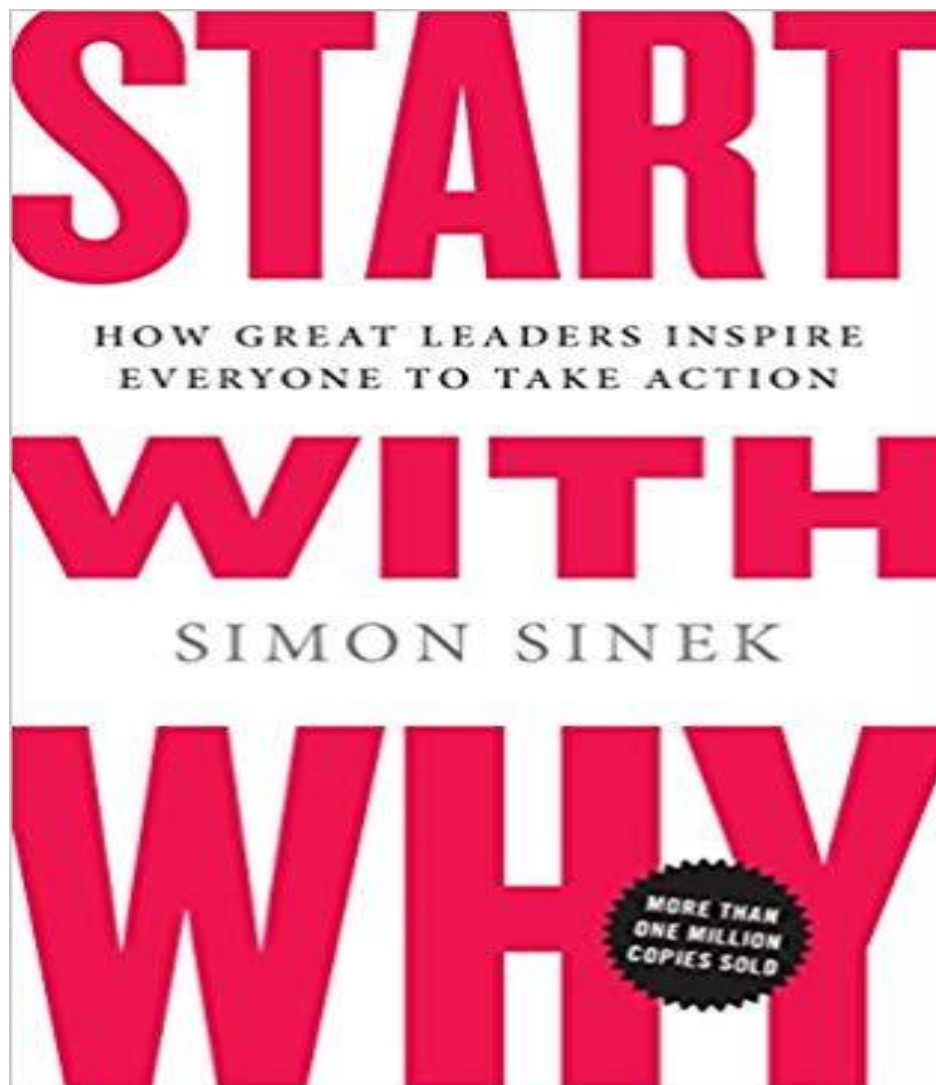


Algorithms of Armageddon: What Happens When We Insert AI Into Our Military Weapons Systems?

Briefing for The Patuxent Partnership
July 14, 2021

George Galdorisi (Captain U.S. Navy – retired)
Naval Information Warfare Center Pacific
Dr. Sam Tangredi (Captain U.S. Navy – retired)
U.S. Naval War College







“Every day, men and women of the United States military **risk their lives** in the defense of the United States and our freedoms. Under extreme pressure and facing **life and death choices**, they do an extraordinary job of protecting the United States in a way that brings honor to our country and our values.”

Lieutenant General Jack Shanahan

Founding Director, Joint Artificial Intelligence Center

Bottom Line Up Front

There are any number of emerging technologies that have the potential to profoundly impact warfare today, tomorrow and well into the future. Without ignoring many of those technologies, we believe that big data, artificial intelligence (BD/AI/ML) will lead the next revolution in military affairs and are worthy of increased attention by those who influence the future of the U.S. military.

The Patuxent Partnership brings together a unique community of interest from a wide-array of organizations who can help accelerate the DoD's use of BD/AI/ML in its platforms, systems, sensors and weapons, *especially* if we want to stay ahead of our peer adversaries who are already leveraging these technologies for military use.

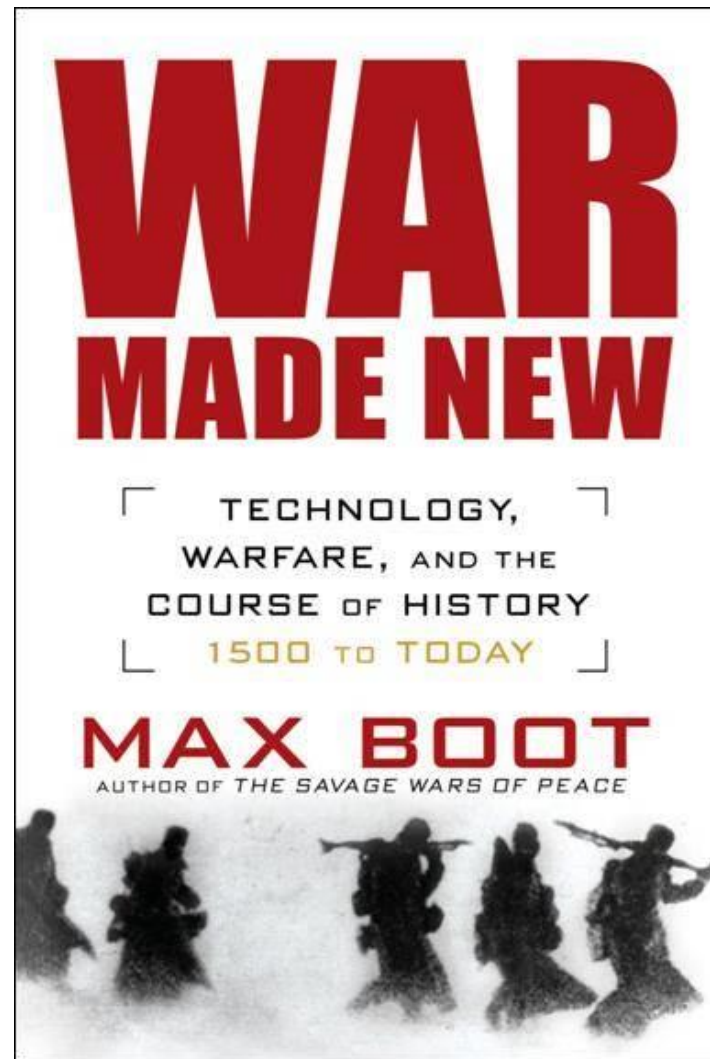
What We'll Talk About Today

- ▼ Strategic Perspective: Return to Peer-to-Peer Competition
- ▼ The U.S. DoD Response: Third Offset Strategy
- ▼ Leveraging Big Data, Artificial Intelligence and Machine Learning
- ▼ Allaying Public Concerns Regarding “Killer Robots”
- ▼ Unmanned Systems: One U.S. DoD Use Case
- ▼ A More Universal Use Case: Better Decision-Making
- ▼ Ensuring That Our Warfighters Can Out-Think Our Adversaries



“My view is that technology sets the parameters of the possible; it creates the potential for a military revolution.”

Max Boot
War Made New





"Tools, or weapons, if only the right ones can be discovered, form 99 percent of victory....Strategy, command, leadership, courage, discipline, supply, organization and all the moral and physical paraphernalia of war are nothing to a high superiority of weapons – at most they go to form the one percent which makes the whole possible."

Major General J.F.C. Fuller

Quoted by Max Boot in

War Made New: Technology, Warfare, and the Course of History 1500 to Today

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“America’s military has **no preordained right to victory** on the battlefield”

U.S. National Defense Strategy

Future Security Environment: Four Contingencies, One Condition



China



Russia



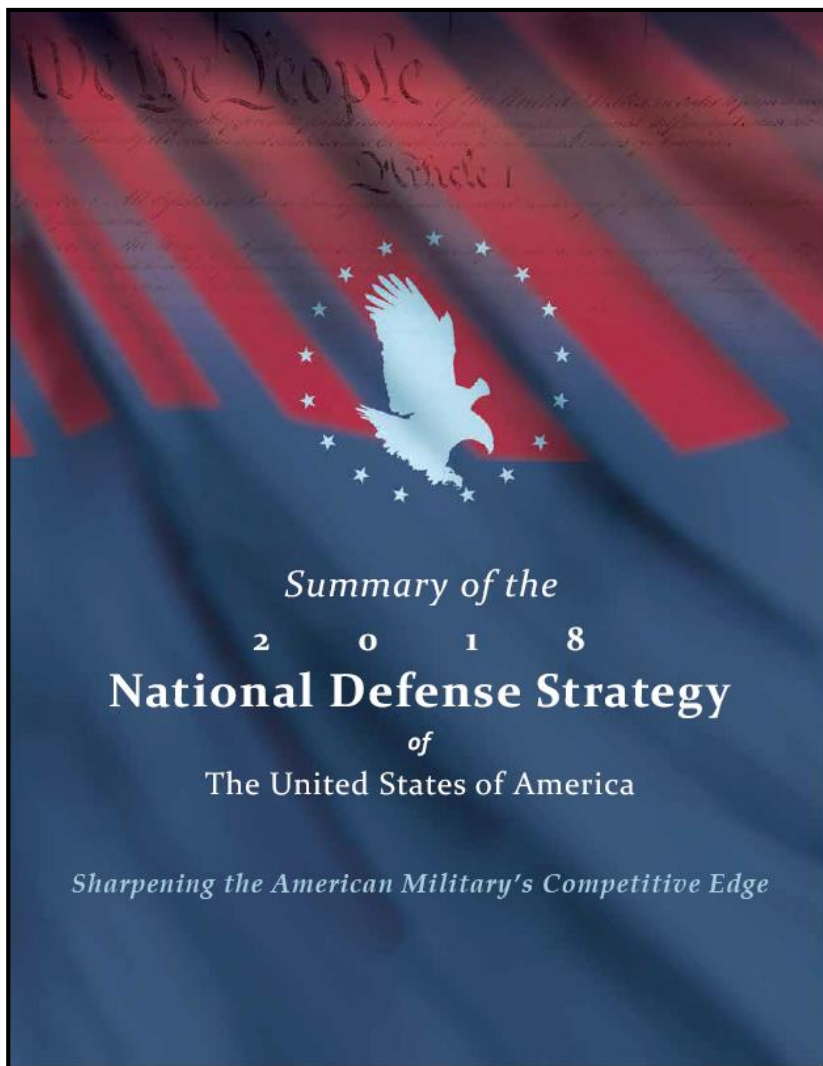
“The Commission wants to convey one big idea. The countries, companies, and researchers that win the AI competition—in computing, data, and talent—will be positioned to win a much larger game.”

National Security Commission on Artificial Intelligence

North Korea



Global Counter-
Terrorism



“The **central challenge** to U.S. prosperity and security is the **reemergence of long-term, strategic competition** by what the National Security Strategy classifies as **revisionist powers**. It is increasingly clear that **China and Russia want to shape a world consistent with their authoritarian model.**”

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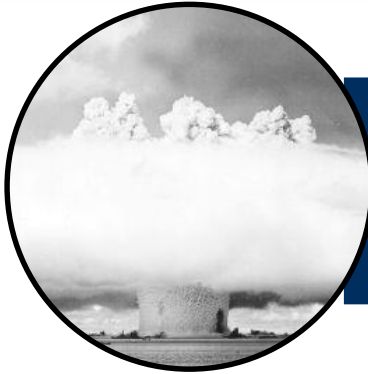


“In coming years and decades, the world will face more intense and cascading global challenges ranging from disease, to climate change, to the disruptions from new technologies and financial crises.

Director of National Intelligence

Global Trends 2040: A More Contested World

Third Offset Strategy



1950s: New Look Strategy



1970s: Offset Strategy



2010s: Defense Innovation Initiative

Components of the Third Offset Strategy

Third Offset Strategy

Defense Innovation Initiative

Long Range
Research and
Development
Plan

Technology

Leadership
Development
Practices

Culture

New Approach
to Wargaming

User Inputs

Operational
Concepts

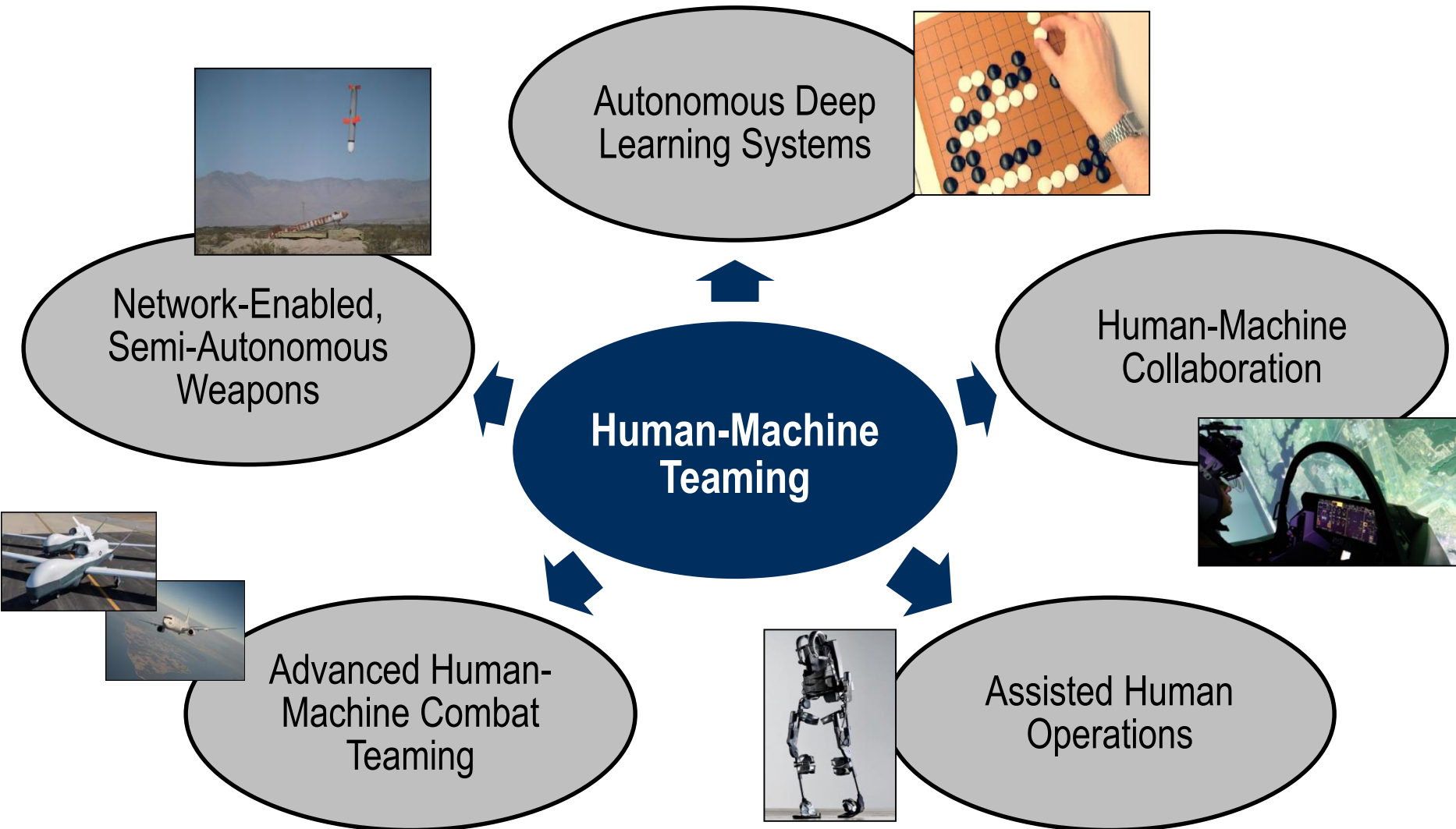
New Users /
Marketplace

Efficient and
Effective
Business
Practices

Processes

Pillars Supporting the Third Offset Strategy

LLRDP Focus: Human-Machine Teaming



Built on a foundation of artificial intelligence and machine learning

What We'll Talk About Today

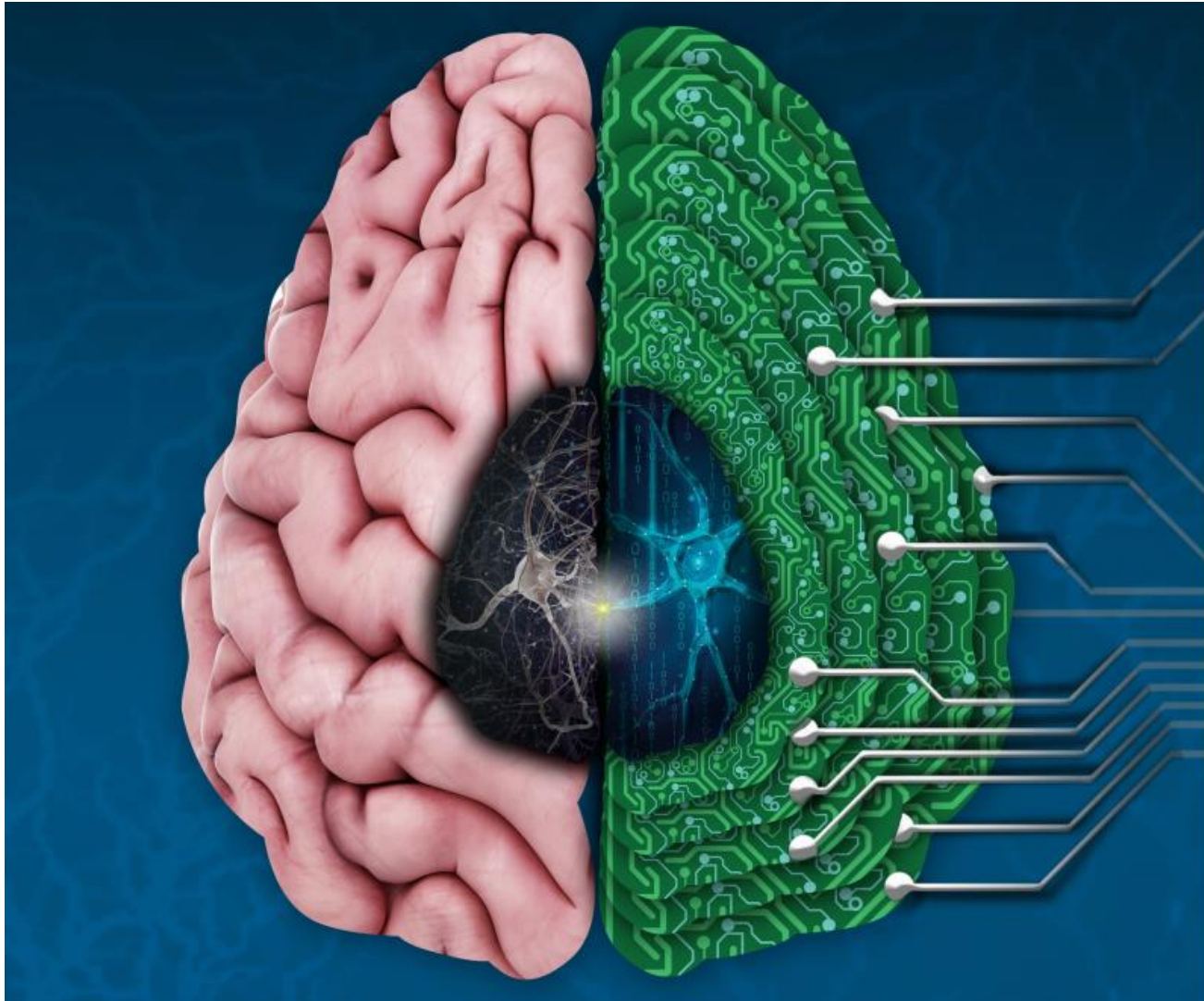
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“**AI and autonomy** should be two of the Pentagon’s modernization priorities. Additionally, the Department of Defense’s **Joint Artificial Intelligence Center (JAIC)** should be the primary tool for guiding and **accelerating the integration of artificial intelligence** into the Department’s missions and activities.”

Dr. Kathleen Hicks
Deputy Secretary of Defense
Senate Confirmation Hearing

Let's Talk About Human-Machine Teaming





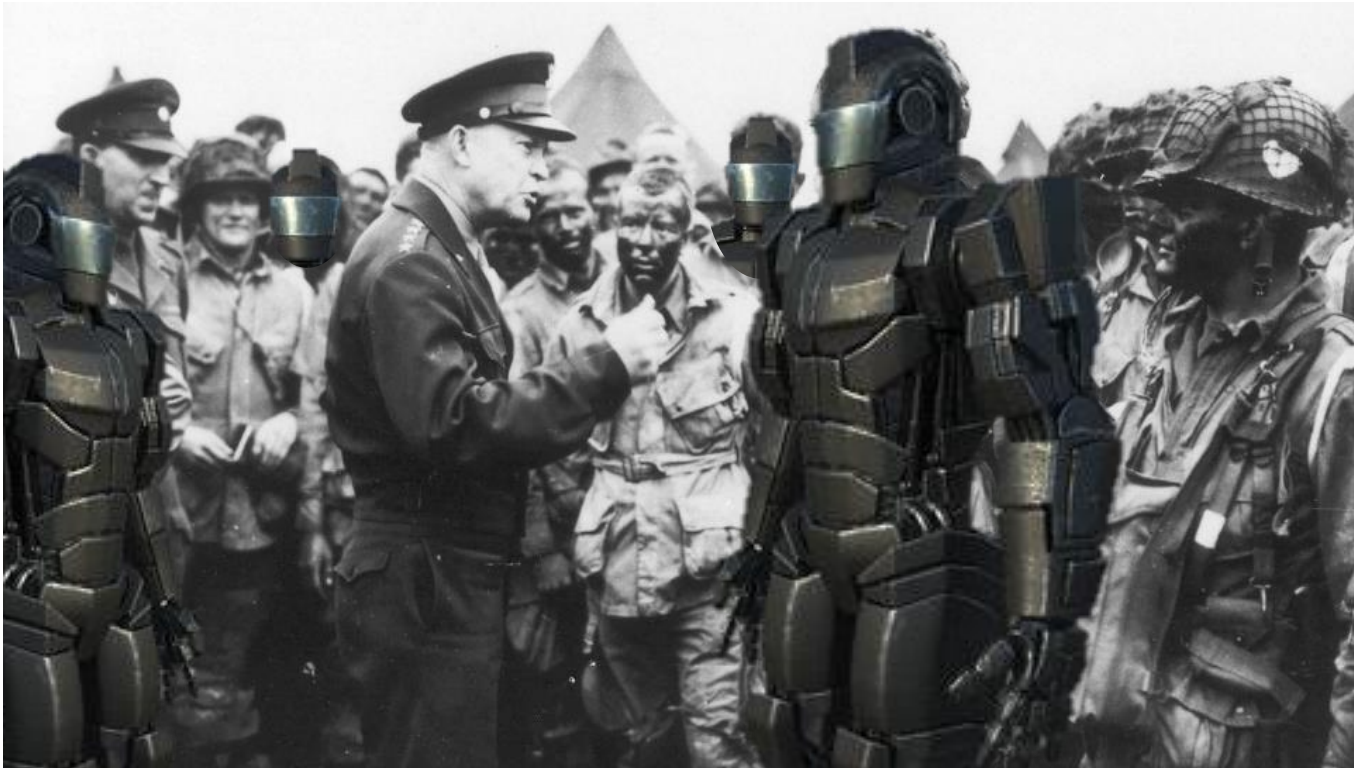
“We can still defend America and our allies without widespread AI adoption today, but in the future, we will **almost certainly lose without it.**”

National Security Commission on
Artificial Intelligence Final Report









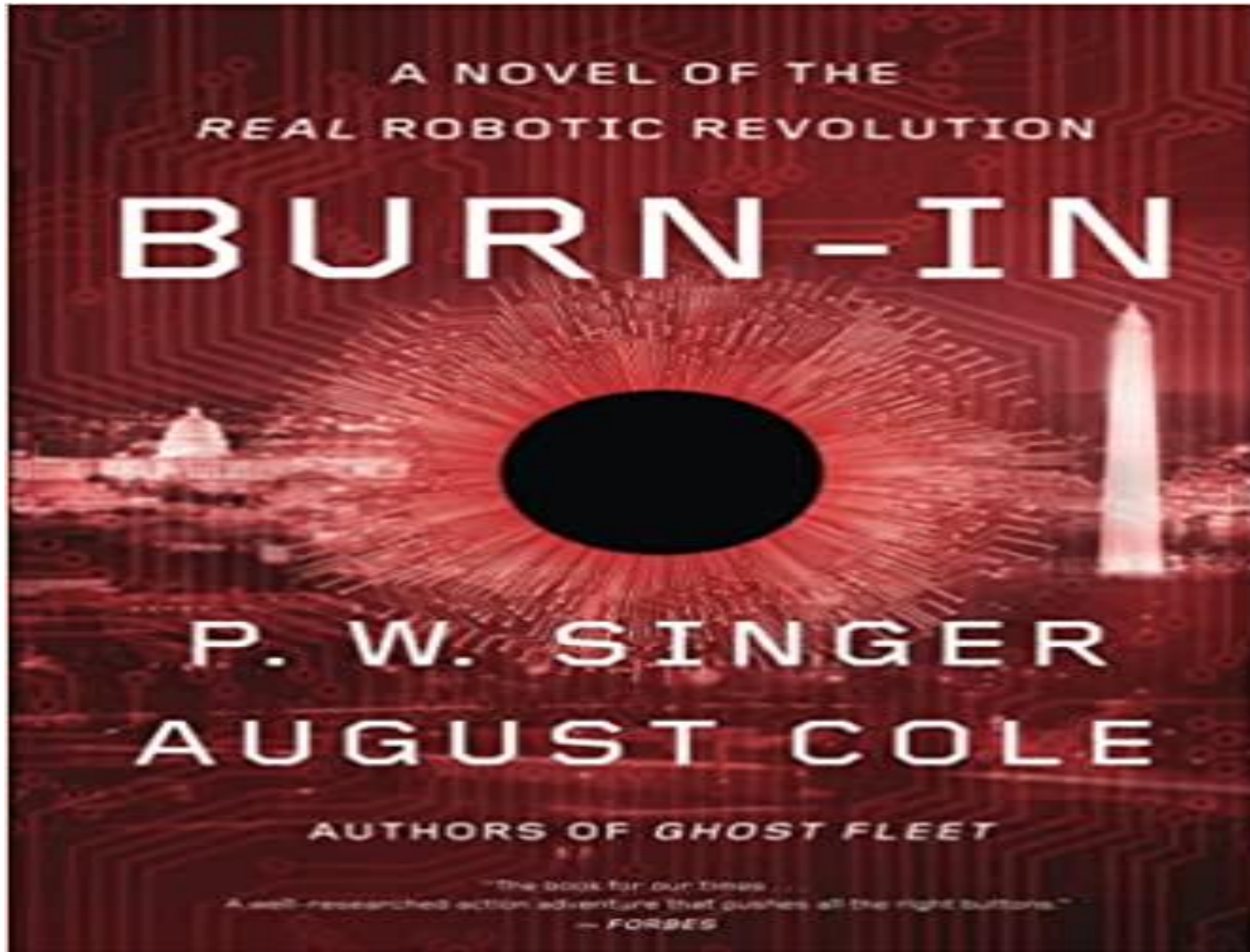


“Humans versus machines is a false choice. **The best systems will combine human and machine intelligence** to create hybrid cognitive architectures that leverage the advantages of each.”

Paul Scharre

*Centaur Warfighting:
The False Choice Between
Humans Vs. Automation*

Human-Machine Teaming In Popular Fiction



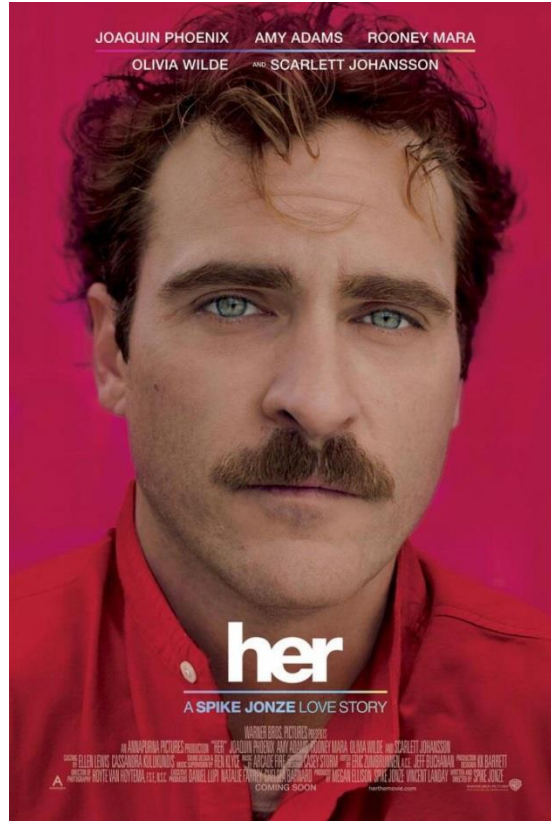
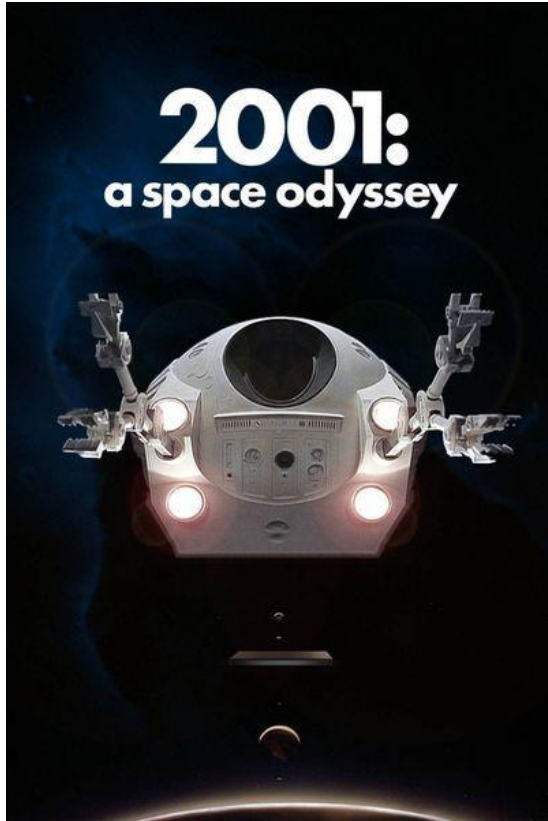
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“Astronauts David Bowman and Frank Poole consider “disconnecting HAL's (Heuristically programmed **AL**gorithmic computer) cognitive circuits when he appears to be mistaken in reporting the presence of a fault in the spacecraft's communications antenna. They attempt to conceal what they are saying, but are unaware that HAL can read their lips. Faced with the prospect of disconnection, HAL decides to kill the astronauts in order to protect and continue its programmed directives.

From Stanley Kubrick's
2001: A Space Odyssey (1968)





“As they become smarter and more widespread, autonomous machines are bound to end up **making life-or-death decisions** in unpredictable situations, thus assuming—or at least appearing to assume—moral agency. Weapons systems currently have human operators “in the loop”, but as they grow more sophisticated, it will be possible to shift to “on the loop” operation, with **machines carrying out orders autonomously**. As that happens, they will be presented with ethical dilemmas...More collaboration is required between engineers, ethicists, lawyers and policymakers, **all of whom would draw up very different types of rules if they were left to their own devices.**”

“Morals and the Machine”
The Economist June 2012



“If you find the use of remotely piloted warrior drones troubling, **imagine that the decision to kill a suspected enemy is not made by an operator in a distant control room, but by the machine itself.** Imagine that an aerial robot studies the landscape below, recognizes hostile activity, calculates that there is minimal risk of collateral damage, and then, with no human in the loop, pulls the trigger. Welcome to the future of warfare. While Americans are debating the president's power to order assassination by drone, **powerful momentum** – scientific, military and commercial – **is propelling us toward the day when we cede the same lethal authority to software.**

Bill Keller “Smart Drones”

The New York Times March 2013



“The theoretical physicist Stephen Hawking told us that “the development of full **artificial intelligence** could spell **the end of the human race.**” Elon Musk, the chief executive of Tesla, told us that **A.I. was “potentially more dangerous than nukes.”** Steve Wozniak, a co-founder of Apple, told us that “computers are going to take over from humans” and that “**the future is scary and very bad for people.**”

Alex Garland

“Alex Garland of ‘Ex Machina’ Talks About Artificial Intelligence”

The New York Times April 22, 2015

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“Over the past several years, the DoD’s main operational AI efforts have been focused on missions such as intelligence, surveillance and reconnaissance; humanitarian assistance and disaster relief; and predictive maintenance.”

Lieutenant General Jack Shanahan

Founding Director, Joint Artificial Intelligence Center



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“Please don’t bring me a shiny new widget and tell me that it’s going to rock my world, unless you can describe my operational environment to me.”

Admiral Scott Swift

Commander, U.S. Pacific Fleet

Keynote address USCD IGCC

Defense Innovation Symposium

January 16, 2019





C4ISR In Action



- ▼ Knowing what is ahead of the strike group
 - The ISR in C4ISR
- ▼ Communicating this information to the strike group
 - The Communications in C4ISR
- ▼ Helping the Commander make the best decision.
 - The C2 in C4ISR
- ▼ All this is undergirded by computers
 - The Computers in C4ISR



“Newer kinds of data analysis and transmission, **enabled by advanced command and control and advanced artificial-intelligence-empowered algorithms**, might make platforms like the MQ-4C Triton as capable in some respects as the much larger, less stealthy and more vulnerable manned P-8 Poseidon.”

“The Strategic Problem of Persistent Surveillance”

The National Interest

June 7, 2021



ISR Mission

- Does the Triton send countless hours of video, or does it alert the operator when a vessel is located?
- When the Triton does find a vessel, does it:
 - Flag it if it isn't following a normal shipping channel?
 - Correlate Automatic Identification System (AIS) data?
 - Show the vessel's port of origin and destinations?
- Does the Triton show areas it should search next based on:
 - Vessels it has found (or not found) in certain areas?
 - Reports of other friendly surveillance systems?
 - Based on GCCS or other reports?
- Does the Triton employ automatic classification algorithms?
- Does it remind the operator of on-station time?



Communications Mission

- Does the Triton assess the electronic environment prior to sending information to the flagship?
- Does the Triton survey multiple communications paths to:
 - Prioritize data transmission based on commanders intent?
 - Determine speed of transmission and time of arrival?
 - Determine levels of vulnerability to communications intercept?
- If the vulnerability of intercept is too high:
 - Does the Triton fly back toward to the flagship to transmit line-of-sight?
 - Does the Triton launch a smaller UAV to fly back to the flagship?
- Does the Triton warn the strike group regarding the overall EW environment?



Command and Control Mission

- Is the Commander presented with well-curated information regarding what is ahead of the force?
- Does the Commander have optimal operational and tactical decision aids?:
 - Is he presented with the pros and cons of moving forward, waiting, or retreating/
 - Is he provided with a well-nuanced idea of where he should scout next?
 - Is he provided with a sense of whether his forces are adequate for the mission?
 - Is he presented with options for additional forces to draw upon?
- Do operational and tactical decision aids provide a range of options for the Commander?:
 - Do they evaluate the pros and cons of various courses of action?
 - Do they suggest areas where additional information is needed?
 - Are they able to develop suggested COAs based on commander's intent?



Lethal Mission (The Bar is Higher)



- What is the level of confidence this person is the intended target?
- What is this confidence based on:
 - Facial recognition?
 - Voice recognition?
 - Pattern of behavior?
 - Association with certain individuals?
 - Proximity of known family members?
 - Proximity of known cohorts?
- What is the potential for collateral damage to:
 - Family members?
 - Known cohorts?
 - Unknown persons?
- What are the potential impacts of waiting verses striking now?



“In 2021, if we have **airman looking at live data feeds**, we have **failed to move the needle** in harnessing artificial intelligence for warfighting effectiveness.”

Major General Michael Groen
Director, Joint Artificial Intelligence Center
Keynote Address
National Security and AI Symposium
March 23, 2021

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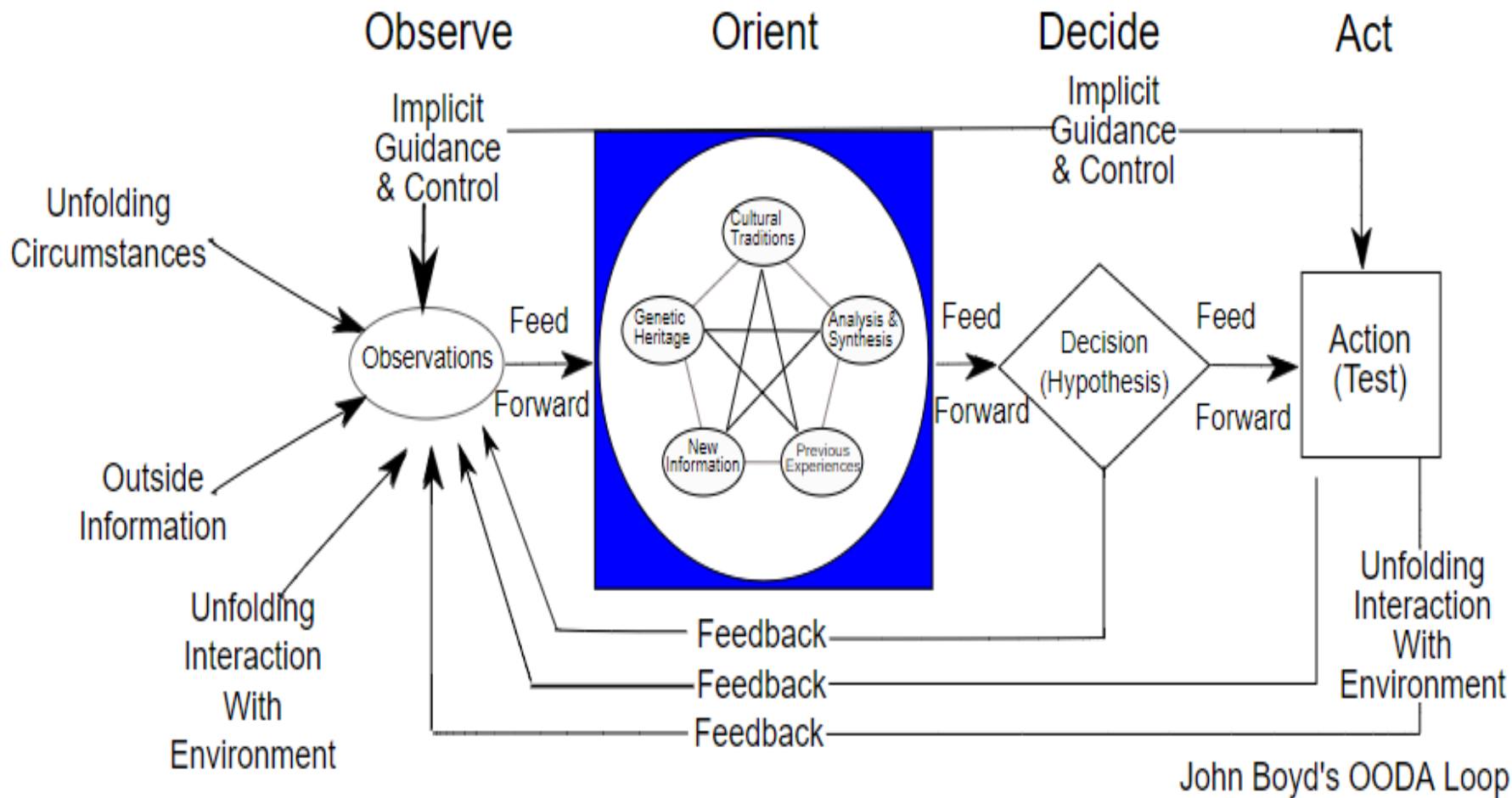


“The most valuable contribution of AI to U.S. defense will be how it **helps human beings to make better, faster and more precise decisions**, especially during high-consequence operations.”

Lieutenant General Jack Shanahan

Founding Director of the Joint Artificial Intelligence Center



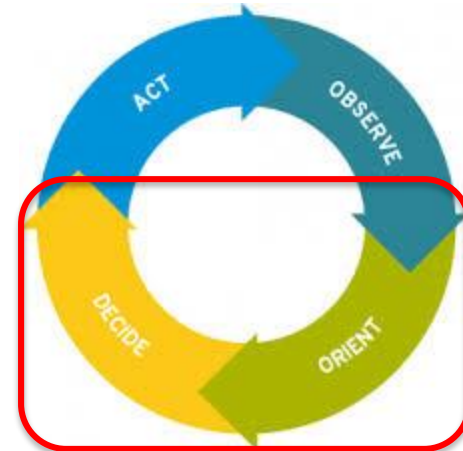


The Changing Character of War

**From:
Traditional Focus**



**To:
Emerging Competition**



**From Precision to Decision...
How Will Big Data, AI, and Machine Learning
Lead This Shift?**

Source: CNO Remarks at the Current Strategy Forum

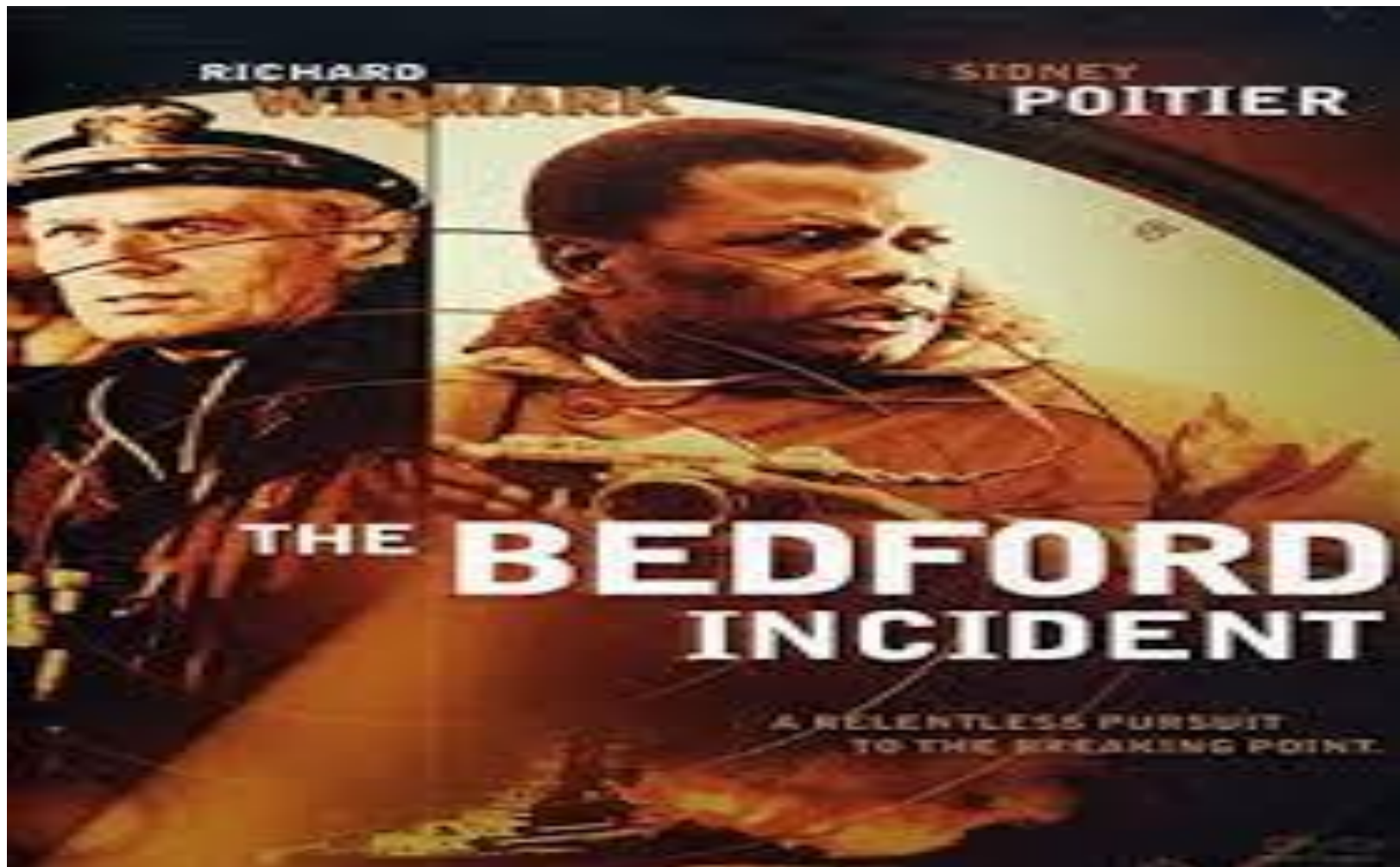
Decision-Making Impacts *All* Aspects Of What Warfighters Must Contend With





“Even though information from radar and other sources could have provided a clear picture of the fighting around them, none of the commanding officers in the Guadalcanal battles were able to develop and maintain a sense of what was really happening. **The problem was not a lack of information, the problem was that there was no facility to integrate and process information into an actionable picture.**”

Learning War, The Evolution of Fighting Doctrine in the U.S. Navy 1898–1945





Have Our Warfighters Had Adequate Information to Make Informed Decisions?

- ▼ 1987: USS *Stark*
- ▼ 1988: USS *Vincennes*
- ▼ 1994: USAF Strike Eagles, USA Blackhawks
- ▼ 2001: USS *Greenville*
- ▼ 2003: Patriot Batteries – Hornet and Tornado shoot downs
- ▼ 2017: USS *Fitzgerald*
- ▼ 2017: USS *John McCain*





“Secretary Austin's memorandum...sets forth a pathway to **enable our leaders and warfighters to orient, decide, and act faster than our competitors.** Doing so requires providing operational commanders with **data-driven technologies, including artificial intelligence, machine learning, and automation...**We must **adopt interoperable AI-enabled sensor fusion, asset tasking, mission autonomy, and real-time decision advantage** planning tools.”

DEPSECDEF Memo

Accelerating Data and Artificial
Intelligence for the Warfighter

June 21, 2021



"The real power of this is to put us in a position where we can actually **decide and act** as a fleet **faster than the opponent.**"

Admiral Michael Gilday

Commenting on Project Overmatch

"West" Symposium

June 30, 2021

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“I would so bold to suggest the **DoD should never buy a weapons system** for the rest of its natural life **without artificial intelligence baked into it.**”

Lieutenant General Jack Shanahan

Founding Director, Joint Artificial Intelligence Center

Suggestions for NPS-Led Efforts to Help Warfighters Leverage BD/AI/ML

- ▼ There are important corporate, training, maintenance and other military challenges that can benefit from BD/AI/ML
- ▼ That said, today's warfighters need BD/AI/ML to help address *operational* challenges (Triton and Decision-Making example)
- ▼ The U.S. JAIC Director suggests going after the low-hanging fruit and just "rolling up our sleeves"
- ▼ There is no more propitious time to collaborate on BD/AI/ML solutions for our militaries than *now*
- ▼ The Patuxent Partnership community of interest can provide stewardship to help further a dialogue in this effort
- ▼ NIWC Pacific has enormous equities in unmanned systems and BD/AI/ML

NIWC Pacific Unmanned Systems History



Autonomous Systems at NIWC Pacific Today

▼ Infrastructure for all UxS domains

- 40+ Active UxS Projects
 - Advanced Autonomy
 - Human Machine Teaming
 - Sensor Fusion
 - Communications
 - Payloads
 - Operational T&E
 - S&T Research

▼ Expert Personnel

- 400+ government scientists and engineers
- 40+ years in unmanned systems



We Make Autonomous Systems Smarter



Channel Nike: “Just Do It” to Get AI Into Our Warfighter’s Hands

A.I. TIMELINE

SZ/GC

1950

TURING TEST

Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence

1955

A.I. BORN

Term 'artificial intelligence' is coined by computer scientist, John McCarthy to describe "the science and engineering of making intelligent machines"

1961

UNIMATE

First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line

1964

ELIZA

Pioneering chatbot developed by Joseph Weizenbaum at MIT holds conversations with humans

1966

SHAKY

The 'first electronic person' from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions

A.I. WINTER

Many false starts and dead-ends leave A.I. out in the cold

1997

DEEP BLUE

Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov

1998

KISMET

Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot insofar as it detects and responds to people's feelings



1999

AIBO

Sony launches first consumer robot pet dog AiBO (AI robot) with skills and personality that develop over time



2002

ROOMBA

First mass produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes



2011

SIRI

Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S



2011

WATSON

IBM's question answering computer Watson wins first place on popular \$1M prize television quiz show Jeopardy



2014

EUGENE

Eugene Goostman, a chatbot passes the Turing Test with a third of judges believing Eugene is human



2014

ALEXA

Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks



2016

TAY

Microsoft's chatbot Tay goes rogue on social media making inflammatory and offensive racist comments



2017

ALPHAGO

Google's A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number (2^{170}) of possible positions

Summary and Suggestions for Further Dialogue

- ▼ As with the U.S. Navy Nuclear Power Program, there is a burden of proof to “first do no harm” with AI-enabled military weapons systems
- ▼ It is likely a bridge too far to “engineer out” all potential ethical issues when inserting BD/AI/ML into military weapons systems
- ▼ Providing operators with the ability to make better decisions, faster, with fewer people and fewer mistakes is the key to success
- ▼ How do this is not a trivial challenge and is worthy of further coordinated effort by military-industry-academic teams
- ▼ To that end, it is important to an ongoing conversation about *how* to mindfully insert BD/AI/ML into military weapons systems



“Never trust anything that can **think for itself** if you **can't see** where it keeps it's brain.”

J.K.Rowling

(Harry Potter and the Chamber of Secrets)



2019

