

A Look into the Future Through the Lens of the Past



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Back to the Futures

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About This Document

This report documents research and analysis conducted by the United States Army War College (USAWC) student team "A Team" as a group Strategic Research Requirement. The report's research, analysis, and production occurred over eight months, from October 2023 to May 2024, as a USAWC Senior Service College curriculum requirement, in support of the completion of a Master of Strategic Studies degree. This product is available in both electronic (PDF) and hard-copy formats. The electronic version is the primary version, as all links in the electronic version are active.

Requirement

This report synthesizes and analyzes open-source documents to answer the following question(s) posed by Lt Gen Anderson, Director, Joint Staff J7, in accordance with the project Terms of Reference (see <u>Annex A</u>).

- a. What factors enabled or facilitated the adoption and convergence of new/disruptive technologies toward implementing visionary concepts? Likewise, what challenges and barriers delayed or prevented this?
- b. What culture fostered adaptation? What operational architectures and decision-making processes induced new strategic focus?
- c. How were visions implemented? What made them successful or caused them to fail?
- d. Regarding future Joint Force Design, how do these historical factors apply to the adoption and convergence of new/disruptive technologies toward the implementation of visionary and innovative concepts in the next 10-15 years?
- e. What are the key lessons from both military and non-military examples that have successfully fostered the development and implementation of visionary concepts, specifically in enhancing the **'elasticity of mind**'? How will these lessons predictively contribute to further enhancing this 'elasticity of mind' among individuals, organizations, and cultures, thus enabling them to adapt innovatively to changing circumstances and to foresee and navigate future challenges effectively?
- f. What individual **attributes** and **skillsets** are predicted to become increasingly crucial for the US Military in the next 10-15 years? What methods or approaches are forecasted to be most effective in educating and training personnel to harness the benefits of synthesizing and applying novel skills and ideas for national defense?

Analytic Confidence

The overall analytic confidence of this report is *moderate*. The questions asked were complex, and the analysts had sufficient time. Source reliability and corroboration were generally moderate to high. The analysts worked individually and collectively to research the answers to the questions. The team used a combination of structured analytic techniques, including the Nominal Group Technique, Multi-Criteria Decision-Making Process, Artificial Intelligence (Chat GPT, Perplexity, Grammarly, POE), and the Millhone Method. The team evaluated the analytic confidence using Analytic Confidence Factors (see <u>Annex F</u>).

Words of Estimative Probability

The Kesselman List of Estimative Words (see <u>Annex J</u>) was used to express the estimative probability of predictions made.

Source Reliability

Source reliability is annotated throughout the document as high (H), moderate (M) or low (L). Source reliability was determined using the Standard Primary Source Credibility Scale (see <u>Annex H</u>) and the Trust Scale and Website Evaluation Worksheet (see <u>Annex I</u>). Reliability annotations hyperlink to the primary sources in the electronic version. For a copy of any of these products, please contact the authors, Professor Samuel White, sam.white@armywarcollege.edu or Professor Kristan Wheaton, kristan.wheaton@armywarcollege.edu.

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Key Finding 1: A Dynamic Defense Innovation Ecosystem is Crucial for Maintaining an Enduring Military Advantage

A dynamic Defense Innovation Ecosystem is almost certainly (86-99%) required to create and maintain an enduring military advantage for the US military now and in the next 10-15 years. The future operating environment will highly likely (71-85%) require national leaders to correctly identify threats to the nation early and support a defense innovation ecosystem that has the adaptability to rapidly shift priorities, efforts, and resources to address the urgency of the challenge.

The Defense Innovation Ecosystem, a term coined recently, started in practice during the Interwar Period (1919-1939). During this period, nations first recognized the importance of organizing their scientific and engineering communities to enhance their military's performance through active funding and guided research. The U.S. scientific research ecosystem, a key contributor to this evolution, was shaped by Vannevar Bush, Director of the Office of Scientific Research and Development (OSRD), established in 1941. The OSRD was an advancement on an earlier initiative by President Roosevelt to centralize planning and government funding for scientific research and development (National Research and Development Council (NDRC), founded in 1940).



Figure 1. Vannevar Bush, circa 1940s (https://images.app.goo.gl/qV19 bgxL4UNvev6B9)

The scientific and engineering minds at OSRD were at the forefront of numerous critical projects, leveraging all scientific disciplines to address the most pressing military challenges. A standout example of their pioneering work is found in the accomplishments of the Massachusetts



Figure 2. OSRD Office Cambridge, MA source: https://images.app.goo.gl/UjNmgjZwv7Y pyj188

Institute of Technology Radiation Laboratory (MIT RAD Lab). This facility was instrumental in the Allies' war effort, making groundbreaking contributions such as developing the air-to-surface vessel radars specifically designed for hunting enemy U-boats and improving the early British IFF (Identification Friend or Foe) system which protected allied pilots returning from missions in low-light conditions. These technological advancements played a crucial role in enhancing the effectiveness of the Allied forces.

Fostering the creation of a dynamic defense innovation ecosystem and its effective management gives national leaders and senior military officials the ability to swiftly adapt priorities, reallocate resources, and redirect efforts in response to emerging threats at the speed of relevance to the challenge. Acknowledging that the current security environment is not "peaceful" can introduce



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a necessary amount of "crisis" energy which, in turn, creates urgency in thought, bureaucratic actions, and processes. Hallmark attributes of a dynamic defense innovation ecosystem are the ability to engage in rapid prototyping, making iterative improvements with each equipment generation, and the industrial capacity to produce material at scale. Military theorists (and strategists) must match the speed of technological advancement with equally rapid development of innovative warfighting concepts. This new dynamic innovation ecosystem must ultimately be paired with an organizational culture that supports the enduring urgency for innovation. Today's modern military innovations directly result from the US military's proactive engagement in a defense innovation ecosystem. This ecosystem typically tends to gravitate toward one end of the competition continuum or the other as a direct result of the nation's perceived threats. Resulting is a dichotomy with "peacetime" versus "wartime" mindsets where differences in urgency between the two dictate the pace of innovation, problem focus, and the policies

governing acquisition authorities for innovative solutions. Many nations traditionally scale back funding on military innovation (research and development) activities during peacetime, believing that innovation will occur at the necessary speed and scale when funding is increased or if conflict occurs. However, the Interwar Period's lessons highlight that a nation must continually cultivate a defense innovation ecosystem that promotes new warfighting intellectual thought and pairs it with a sufficiently funded quadruple helix of innovation to produce the military capabilities to prevail when needed.



Figure 4. US DOD Innovation Ecosystem (www.ctoinnovation.mil/innovation-ecosystem)

The most prominent example of a nation that effectively combined these concepts to create a military advantage is Germany in the 1930s. By contrast, Great Britain, France, and the United States all transitioned back to a peacetime defense innovation ecosystem after World War I which left these nations completely ill-prepared to face Germany's wartime stance and pace of innovation. This situation could have been avoided with a dynamic innovation ecosystem that allowed a nation to increase funding for research and development early and steadily, provided intellectual focus to address capability and doctrine gaps, and ensured the industrial base capacity existed to fight and win while avoiding a transition to a total war economy.

In the evolving landscape of defense innovation, a more fluid continuum, vice traditional paradigms, will more effectively harness the collective innovation power of the nation. Historically, the defense innovation ecosystem has been perceived as encompassing two poles: steady state innovation and existential innovation. However, this binary viewpoint is no longer sufficient to address the complex threats of the current security environment facing the United States and the rapid pace of technology advancements.

The concept of describing nation state interactions as a continuum offers a nuanced approach when describing adversarial states' interactions. Building on this model, a more nuanced approach to innovation emerged that illustrates the urgency of the environment, and that innovation is not only possible but can also accelerate under certain conditions. This shift is essential for maintaining long-term stability and responsiveness within the defense sector.

Accelerating innovation requires a strategic vision that proactively identifies potential adversaries, along with when, where, and how we will need to fight to prevail. This vision must be matched with a pervasive culture of innovation that encourages creativity and adaptability. To achieve this, there must be a concerted effort to leverage the diverse expertise and perspectives from within the military and external partners found in academia and industry. Connecting these sectors (military, academia, industry, and society) and encouraging collaboration ensures ready access to unique insights and skills, making potential innovations invaluable in closing the capabilities gaps that could otherwise hinder effective military strategies.



Figure 5. Defense Innovation Ecosystem Continuum

Furthermore, embracing the 'elasticity of mind' within these sectors will be pivotal. This concept refers to the ability to adapt one's thinking and approaches in response to changing

circumstances—a quality that is indispensable in today's fast-paced and uncertain global landscape. By fostering this mindset, we can ensure that the defense innovation ecosystem is not only equipped to handle current challenges but is also prepared to anticipate and adapt to mitigate future threats.

Key Finding 2: Strategic Vision is Key to Military Preparedness and Success

Strategic vision serves as the basis for Grand Strategy, providing overall direction and alignment of the instruments of national power. Successful preparation for the "next" war is derived from a clear strategic vision, predicated on adequately understanding the current strategic environment and projecting not only when, where, and who we will fight, but also how we will need to fight to prevail - what technologies, concepts, tactics, and other



Figure 6. The Art of Developing a Strategic Vision. Click on the picture or go to: https://danielpuiatti.com/mastering-the-art-of-developing-a-strategic-vision/<u>. Source: danielpuiatti.com</u>

attributes will dominate the future battlefield? Strategic vision must provide clear direction for military preparation and a convincing demand for resource allocation.

Strategic vision is highly likely (71-85%) to be the critical determinant in force design and is almost certain (86-99%) to guide military innovation efforts into valuable concepts and new doctrines.

While all belligerents between World War I and World War II created military innovations, the German military's proactive approach to technological development, driven by a strategic vision that embraced maneuver warfare and operational mobility, fostered an environment conducive to innovation. German leaders aligned diplomatic and economic efforts to rearm its military throughout the 1920s and 1930s (in violation of the Versailles Treaty), and within two decades, Germany climbed from a "third-rank power" to ultimately unleash one of the greatest fighting forces the world had ever seen. In contrast, France's more reactive stance, influenced by a defensive-oriented purpose and characterized by intellectual rigidity, hindered its ability to adapt and innovate effectively.

Soviet strategic vision effectively industrialized its military and the subsequent mechanization of the Red Army, which enabled the development of the Russian "Deep Battle," a concept that combined shock troops, mobile armor maneuvers, and airpower to attack and penetrate deep into an enemy's rear. Unfortunately, its implementation was severely stalled due to Stalin's purges of military elites.

Japan's strategic vision was informed by military elites and Emperor Hirohito, who reportedly shared power with them. The nation's goal was expansion, and its geographical and perceived operational needs ultimately prioritized naval and air power, thus limiting the Army's ability to innovate and mechanize effectively. Therefore, Japan was a leader in naval carrier aviation at the beginning of World War II, yet its Army virtually discarded all use of mechanized tanks.

U.S. military preparedness prior to World War II reflected deep political and public sentiments of international isolationism. National security goals and funding were meager, which centered on defending the homeland, the Panama Canal, and overseas operations in the Philippines and China. Consequently, the Navy received funding priority over the Army, which limited the Army's ability to innovate. While the Navy was also fiscally challenged during this period, it was able to correctly anticipate its likely opponent in the next war – the Empire of Japan –

	US MILITARY	PERSONNEL	(1939-1945)
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Year	Army	Navy	Marines	Coast Guard	Total	
1939	189,839	125,202	19,432		334,473	
1940	269,023	160,997	28,345		458,365	
1941	1,462,315	284,427	54,359		1,801,101	
1942	3,075,608	640,570	142,613	56,716*	3,915,507	
1943	6,994,472	1,741,750	308,523	151,167	9,195,912	
1944	7,994,750	2,981,365	475,604	171,749	11,623,468	
1945	8,267,958	3,380,817	474,680	85,783	12,209,238	
*Coas	t Guard listed	only as wartin	ne strength			

Figure 7. U.S. Military Personnel Strength. Click on the picture or go to: https://www.nationalww2museum.org/studentsteachers/student-resources/research-starters/research-startersus-military-numbers. <u>Source: National World War II Museum</u>

and used its limited resources to develop a formidable aircraft carrier capability and, in concert with the Marine Corps, the amphibious doctrine that facilitated victory in both major theaters of the war.

Strategic vision shapes force design via seven key drivers: direction and purpose, technology integration, adaptability to emerging threats, resource allocation, training and doctrine development, interoperability and alliances, and innovation and experimentation. Innovation champions are crucial to the creation, refinement, and realization of strategic vision. They actively advocate for, protect, and envision the deployment of emerging technologies, lead the transformational changes vital for integrating advancements into military strategy and tactics, link innovative concepts with military requirements, advocate for their adoption, and safeguard projects against the bureaucratic and resource hurdles inherent in government organizations.

The U.S. military is likely (56-70%) to struggle at the outset of a major conflict within the next 10 years.

The United States has historically been unprepared for war. The nation struggled at the outset of most major conflicts in history, including the War of 1812 against Great Britain, the Mexican American War in 1846, the Spanish-American War in 1898, World War I (entering in 1917), World War II (entering in 1941), and the Korean conflict in 1950.

Global events in recent decades have been described as highly Volatile, Uncertain, Complex, and Ambiguous (VUCA), and the ongoing conflicts in Europe and the Middle East foretell that this sentiment is unlikely (31-45%) to abate in the near future. Despite the flexibility of integrated deterrence (National Defense Strategy), strategic discipline (National Military Strategy), and the Joint Warfighting Concept, significant ambiguity toward the "next conflict" still remains.

The current National Defense Strategy prioritizes defense of the homeland, followed by the People's Republic of China as the "pacing challenge; however, according to the March 2024 Defense Budget Review (revised April 2024), FY25 defense spending for overseas operations projects \$9.9B for USINDOPACOM, \$4.2B for Europe, and \$17.1B for USCENTCOM.

Domestic factors further challenge U.S. military preparedness for the next conflict. Without the demand signal of a conflict to maintain or increase defense spending, the Department of Defense can expect reductions in its funding within larger efforts to reduce the federal deficit by reducing

discretionary spending. Growing domestic sentiments of military and economic retrenchment in U.S. foreign policy are also likely (56-70%) to further decrease military preparedness.

Despite unpreparedness at the outset of a major conflict, historical trends show that an updated strategic vision, including more directive policies related to the conflict, as well as an increase in associated defense spending, is highly likely (56-70%) to enable rapid military innovation (see Figure 8).



Figure 8. U.S. Defense Spending in Percent GDP from 1800-2024. Click on the picture or go to:

https://www.usgovernmentspending.com/spending_chart_1800_2024USp_ 25s2li011tcny_30f_20th_Century_Defense_Spending.<u>Adapted from source:</u> usgovernmentspending.com

Ethical governance is highly likely (71-85%) to impede AI development for military applications.

Throughout the 1920s and 1930s, Germany bypassed the Treaty of Versailles via the 1922 Rapallo Treaty with the Soviet Union, which enabled Germany to covertly develop and test weapons and conduct military training on Soviet territory. Meanwhile, Japan engaged in egregious acts of violence in China, such as the December 1937 Nanjing Massacre. However, the United States turned inward, adopting an isolationist stance in the face of Axis expansionism.

Today, the United States maintains a solid commitment to ethical governance, emphasizing responsibility and compliance with international norms. Meanwhile, China and Russia opt for a more pragmatic approach, prioritizing state security and military modernization by sidestepping specific ethical and human rights concerns.

The ramifications of these divergent ethical frameworks on global security, human rights, and international cooperation could destabilize international security architectures, erode global norms, and precipitate a security dilemma characterized by rapid, unchecked AI deployment fueled by the pursuit of AI superiority without adequate ethical safeguards.

Supply chain security and innovation are highly likely (71-85%) to be necessary for success in future warfare.

The U.S. military has grown accustomed to unchallenged supply chain environments. However, rapid technological advances are accelerating the pace of non-kinetic disruptions to the U.S. military supply chains. Autonomous Additive Manufacturing (AM) robotics is highly likely (71-85%) to increase the quality of manufactured components through increased automated robotic systems at sites to augment the capabilities of user manufacturers. This builds human-robot collaboration and expands the capacity for evolving demands on military supply chains.



Figure 9. Defense Logistics Agency Supply Chain Architecture. Click on the picture or go to: https://www.dla.mil/Info/Strategic-Plan/Supply-Chain-Security-Strategy/<u>. Source: dla.mil</u>

Despite conventional supply chains' reliance on disjointed communication lines, blockchain technology's role in enhancing military logistics – by eliminating single points of control and failure – will likely (56-70%) transform and fortify military supply chains in the next decade.

Key Finding 3: New Horizons in Defense: Elevating Innovation and Adaptability Across All Levels of Military Organization Culture

Historically, military organizations that incorporate adhocracy traits (agility, creativity, and openness to risk) at all levels, including in education, personnel management, and operational processes, are highly likely (71-85%) to show increased innovation and adaptability. Despite the inherent resistance to change in hierarchical military cultures, organizations that adopt adhocracy traits throughout their systems and daily operations benefit significantly. This cultural shift not only empowers strategic decision-making at the leadership level by fostering a more dynamic approach to challenges but also enhances operational flexibility at all levels, enabling for more responsive and effective tactics These widespread changes are expected to significantly boost the organization's ability to innovate over the next 10-15 years. By effectively utilizing educational programs, personnel management systems, and operational processes, these organizations can more efficiently absorb lessons from operational environments, develop new operational concepts, increase experimentation, adjust to changes, and leverage emerging technologies and theories.

As technological innovation accelerates, organizations must adapt to the changing environment to innovate, leverage technology, and influence the innovation ecosystem effectively. The culture of an organization plays a key role in determining its innovation capacity and technology utilization. An adhocracy culture is characterized by its flexibility, empowerment of personnel,



Figure 10. Adding adhocracy traits to military culture fosters creativity and empowerment, paving the way for strategic innovation (https://fastercapital.com/content/Innovation--Unleashing-Innovation--The-Power-of-Adhocracy-in-the-Workplace.html)

and dedicated focus on innovation (See Shift Toward Adhocracy Culture Report). This marks a departure from the traditional hierarchical structures that historically dominated military organizations. Unlike a hierarchal culture that prioritizes structure, order, and stability; adhocracies excel in agility, creativity, and openness to risk-taking (See Figure 10). Adopting an adhocratic approach in the military context enables rapid adaptation to modern warfare's evolving conditions, fosters unconventional strategic

thinking, and facilitates the development of innovative solutions to complex defense challenges.

Empowering subordinate leaders with autonomy is crucial for fostering an agile and adaptive military force. This empowerment enables rapid, and informed decision-making at critical moments, promotes a culture of risk-taking and experimentation, and accelerates the

development of innovative concepts. Such a dynamic approach not only cultivates ongoing innovation but also secures a strategic edge in rapidly evolving conflict scenarios, ensuring that military forces are better equipped to respond to unexpected challenges.

Professional Military Education (PME) actively fosters a culture of innovation by equipping personnel with critical thinking skills and technological literacy, deepening their understanding of complex systems, and offering extensive opportunities for war-gaming and experimentation. PME cultivates adaptability and a commitment to continuous learning, which are crucial for driving innovation and achieving strategic and operational excellence in rapidly evolving military contexts. In the promotion of interdisciplinary education and encouraging cross-functional collaboration, PME plays a pivotal role in breaking down silos and fostering a holistic view among military leaders, further enhancing their capacity to innovate and respond to dynamic challenges.

Experimentation and iteration are critical factors for increased innovation. Conducting experimentation provides a structured, low-cost, and low-risk way to empirically test new ideas, concepts, and prototypes, crucial for driving continuous improvement and organizational effectiveness. By embracing an iterative process, organizations can rapidly identify and refine viable solutions, significantly reducing wasted resources and accelerating development timelines.

Innovative reforms in personnel management that increase flexibility and diversify career paths significantly enhance a military's innovation capability. These reforms promote advanced education and industry collaboration, crucial for developing a diverse and skilled workforce capable of implementing advanced strategies and technologies.

Innovation champions are indispensable leaders who actively advocate for, protect, and envision the deployment of emerging technologies; thereby, effectively closing the gap between innovative ideas and their practical application in military operations. They do not simply support the adoption of new technologies; rather, they lead the transformational changes vital for seamlessly integrating these advancements into military strategy and tactics. The hallmark of these champions is their adeptness at linking innovative concepts with military requirements, advocating for their adoption, safeguarding projects against the bureaucratic and resource hurdles inherent in military organizations, and projecting the widespread use of these technologies to enhance operational effectiveness. ^M Leslie Groves exemplified an innovation champion for the Manhattan Project. He not only advocated for and protected the development of nuclear technology but also directed its integration into military operations, effectively bridging the gap between scientific innovation and practical application. Groves led transformational changes, overcame bureaucratic and resource challenges, and linked nuclear fission to critical military requirements.

As technological innovation accelerates, military organizations must adapt by embracing more flexible and diverse career paths. This enhances the organization's capacity to innovate and adapt, with an increasing emphasis on both command and technical expertise crucial in a dynamic environment. This strategic inclination towards a flexible, innovation-friendly culture is essential for maintaining competitive advantage and operational readiness in the face of evolving global challenges.

Military organizations that cultivate robust collaborations across the quadruple helix comprising academia, the private sector, government, and civil society—significantly enhance their innovation and adaptability. These collaborations actively facilitate the rapid assimilation and deployment of cutting-edge technologies and advanced research into practical military applications, securing a competitive edge. By leveraging diverse expertise and resources, these partnerships drive strategic, operational, and tactical innovation. To maintain and advance this momentum, military organizations must continue to strengthen these partnerships.

Royal Air Force Innovative Culture

During the interwar period, the British military, especially the Royal Air Force (RAF), exemplified an innovative culture across all levels of its organization. This era marked significant advancements in technology and military tactics, most notably in the development and operational integration of radar technology.

Cultivation of Innovation Culture:

British military leadership recognized early the potential impact of air power and the need for technological superiority in warfare. This foresight led to a strategic emphasis on technologies (such as radar) that could ensure Britain's air defense capabilities, particularly against the growing threat of German aerial attacks.

Professional Military Education and Technical Training:

The RAF invested heavily in professional military education and technical training, establishing institutions such as the RAF College Cranwell, which became a center for aeronautical engineering excellence. The curriculum covered not only traditional military tactics but also encouraged innovative thinking around new technologies (radar). This educational focus prepared personnel to work with emerging technologies and fostered a culture of continuous learning and adaptability.

Empowerment and Autonomy in Technological Experimentation:

Led by scientists and military leaders like Sir Robert Watson-Watt, the radar development team operated with significant independence, allowing for rapid experimentation and development. This autonomy proved crucial for the swift transition from experimental radar systems to fully operational ones capable of detecting incoming aircraft at long distances.

Innovative Personnel Management Practices:

During this period, the RAF's personnel management practices emphasized flexibility and crossdisciplinary collaboration between engineers, physicists, and military strategists. This approach facilitated the integration of diverse expertise, crucial for the complex technological innovation that radar represented.

Promotion Outside of Command

After WWI, Brigadier General Trenchard, a visionary leader, championed the establishment of the RAF as a separate, independent force. He advocated for using air power strategically, not merely for reconnaissance or supporting ground troops. Despite his lack of senior command experience, Major General Trenchard's ideas found resonance with the civilian leadership, particularly with Prime Minister Stanley Baldwin. Recognized for his strategic thinking, he was appointed Chief of the Air Staff (CAS) in 1918, becoming the leader of the newly formed RAF. This promotion bypassed several senior officers who would typically have been expected to take the role based on the traditional command structure.

Role of Innovation Champions:

Sir Robert Watson-Watt and his team served as innovation champions within the RAF, pushing forward the radar project despite significant technical challenges and skepticism from traditional military factions. Their ability to link the RAF's strategic needs with cutting-edge scientific research was instrumental in the successful development and deployment of radar.

Adapting to Technological Innovations:

By the late 1930s, the RAF's successful deployment of radar dramatically enhanced Britain's defensive capabilities, most notably during the Battle of Britain. The foresight in radar development not only provided a strategic edge but also demonstrated the effectiveness of adapting an organizational culture to leverage new technologies.

The British military's focus on radar technology during the interwar period is a prime example of how a culture of innovation, supported by strategic education, empowerment, and flexible personnel management, can significantly enhance a military force's capabilities. This case study illustrates the critical importance of fostering an adaptable, innovation-oriented culture within military organizations to maintain technological superiority and operational readiness in the face of evolving global threats.

Key Finding 4: Sustaining Military Superiority through the Quadruple Helix Model: A Strategic Framework for Enhancing Innovation and Technological Advancement in the U.S. Armed Forces

The Quadruple Helix Model is highly likely (71-85%) to enhance and elevate military innovation, adaptability, and technological advancement to maintain an enduring military advantage for the U.S. Armed Forces in the next 10-15 years.

The Quadruple Helix Model is an innovation framework that includes collaboration, interactions, and relationships between academia (universities, colleges), private sector (industry, companies) and government (federal government, state, local, interagency,) and civil society (community groups, non-profit, NGO's, people). This model emphasizes the importance of collaboration among these four key actors in fostering innovation and driving socio-economic development.



Figure 11. The Quadruple Helix Model was adapted by Fraunhofer (2016) and initially developed by Carayannis and Campbell (2009). Copyright © 2015 Fraunhofer (https://www.researchgate.net/figure/Quadrupl e-Helix-Innovation-System-Visualization_fig2_356067458)

The Quadruple Helix Model remains crucial for advancing military doctrine through the development of groundbreaking technologies, leveraging the collective expertise and resources of academia, industry, government, and civil society. Despite the challenges of aligning and maintaining cooperation among diverse stakeholders, the successful implementation of this model is demonstrated by historical precedents such as the United Kingdom's development of radar technology in the 1930s. Spearheaded by the government through the Air Ministry, this initiative successfully coordinated essential R&D contributions from universities, setting the theoretical foundation and exemplifying effective collaboration.



Figure 12. Radar 1930's Air Ministry (https://www.engadget.com/2016-01-14-first-radar-station-heritage-grant.html)

The Quadruple Helix model, emphasizing collaboration among government, academia, industry, and civil society, was crucial in enhancing the United Kingdom's national security through the development of radar technology during the Interwar period. This comprehensive approach significantly bolstered the RAF's capabilities during the Battle of Britain. Civil society's role was

particularly notable; grassroots efforts and amateur radio enthusiasts provided essential groundwork for technological advancements. The Story of H2S Radar," local clubs and amateur radio operators were pivotal in refining radio wave techniques that were crucial for the development of radar. Industry contributions were also significant, with firms like Metropolitan-Vickers and BAE Systems effectively translating academic research into operational technology. These efforts were underpinned by widespread public support and media advocacy, emphasizing radar's critical role in national defense. This integrative effort not only advanced military technology but also showcased the effectiveness of collaborative, cross-sector partnerships in achieving significant technological milestones.

The development of the F-35 Lightning II Fighter plane illustrates the success of the Quadruple Helix model, where collaboration among government, academia, industry, and civil society significantly boosts national security capabilities (see Figure 13). In the case of the F-35, civil society—through advocacy groups and defense-oriented think tanks—played an essential role in influencing public policy and shaping the funding strategies essential for the program's success. These groups facilitated critical discussions on the national defense needs and the strategic significance of incorporating advanced fighter technology, ensuring sustained public and legislative support. Industry leaders like Lockheed Martin were at the forefront of the design and manufacturing process, utilizing pioneering research from academic entities and technological contributions from government defense research agencies.



Figure 13. F-35 Lightning II Program Status and Fast Facts (https://ifunny.co/picture/july-5-2022-f-35-lightning-ii-program-status-and-JkNedbPh9)

According to Aerospace and Defense Technology (2020), the Quadruple Helix Model's governance mechanisms effectively aligned varied objectives and managed potential conflicts, contributing significantly to the project's success. These strategic frameworks will likely continue to balance and integrate the interests and aims of numerous stakeholders effectively. This ensures that innovations are not only technologically advanced but also broadly acceptable and durable, highlighting the model's ongoing relevance and efficacy in complex defense projects.

The Quadruple Helix Model is crucial in integrating technological innovations such as Artificial Intelligence (AI) into military strategies, notably enhancing outcomes and adapting to challenges like AI-driven cybersecurity. This model effectively coordinates collaboration across government, academia, industry, and civil society, essential for addressing the ethical and operational challenges AI introduces to military contexts. Civil society is instrumental in advocating for ethical standards and enhancing public engagement and transparency in AI initiatives. Civil society organizations, including watchdog groups and policy think tanks, play a critical role. These entities work to ensure that AI technologies in defense align with societal values and human rights, influencing policy frameworks and promoting a balanced approach to the opportunities and risks of AI in military applications. The sustained success of the Quadruple Helix Model highlights its effectiveness in ensuring that military strategies are not only innovative but also ethically aligned with the complex dynamics of modern warfare



Figure 14. Digital On-Demand connects the Quadruple Helix Model to shape technological innovation (https://www.ai.mil/docs/DigitalOnDemand_Slick%20Sheet_20240206.pdf)

During the interwar period of 1919-1939, the rapid development and implementation of tank warfare and combined arms tactics under General Heinz Guderian fundamentally transformed



Figure 15. Westinghouse - Mechanical Man and Dog (Elektro and Sparko) - Elektro and Sparko (https://www.theoldrobots.com/images111/Electr o-10.JPG)

military operations, highlighting the pivotal role of innovative and integrated military strategies. This historical example underscores the enduring need for adaptation and forward-thinking in military doctrines. In a similar vein, today's advancements in AI and cyber defense, epitomized by initiatives such as the creation of the Chief Digital and Artificial Intelligence Office, continue to push technological boundaries. These modern efforts not only advance national security but also set new standards for the ethical use of AI, balancing cutting-edge technology with critical ethical considerations. This evolution reflects a commitment to integrating progressive technologies while ensuring they align with core military values and ethical standards.

The Quadruple Helix Model, emphasizing collaborative innovation, has consistently demonstrated its value in advancing military technology through both historical and contemporary achievements. During the Tizard Mission of 1939-1940, companies such as General Electric and Westinghouse played pivotal roles in scaling the production of radar technology and the cavity magnetron, key innovations that contributed to the Allied victory in World War II. This period underscored how industrial capacity, under collaborative frameworks, could expedite advancements in military technology. Moving into the 21st century, the enduring relevance of this model is evident in the commercialization and military adaptation of drones. Companies like DJI and General Atomics have not only pushed drone technology forward for recreational and commercial uses but have also adeptly tailored these advancements to meet military needs, incorporating sophisticated imaging and communications technologies for enhanced surveillance and reconnaissance. This ongoing evolution showcases the model's capability to integrate cutting-edge technology with strategic military applications, ensuring that innovations remain both relevant and operationally effective.



Figure 16. DARPA Continuing collaboration with Quadruple Helix Model (https://www.darpa.mil)

Key Finding 5: The Importance of Elasticity of Mind in Military Leadership

"Elasticity of mind," or cognitive flexibility, is highly likely (71-85%) to be a critical attribute of successful leadership and innovation in the military and technology sectors. This trait is essential for military leaders who develop innovative strategies and adapt effectively to changing paradigms. For example, General Hans von Seeckt's introduction of the Blitzkrieg concept through his reforms of the Reichswehr significantly altered traditional warfare tactics, demonstrating how strategic foresight can transform military operations. Similarly, General Billy Mitchell's early advocacy for the strategic use of air power anticipated the significant role that aircraft would play in future combat, reshaping U.S. military tactics and strategy. These examples are echoed in the civilian sector by figures like Elon Musk, whose groundbreaking work at SpaceX has disrupted aerospace norms. This shows the transformative impact of cognitive flexibility, illustrating its pivotal role in fostering innovative approaches that transcend traditional boundaries and initiate new operational paradigms.

Cognitive flexibility relies on neurogenesis (which involves the generation of new neurons in the brain), particularly in the hippocampus, which is crucial for memory and learning. Activities stimulating new learning and physical engagement enhance this process, improving the brain's adaptability and neuroplasticity. The prefrontal cortex, essential for decision-making and behavior regulation, integrates these functions and interacts with the dopaminergic system, where dopamine levels affect adaptability and creativity. This knowledge is essential for optimizing brain function and enhancing mental capabilities throughout life.

Cognitive flexibility is highly likely (71-85%) to be improved by engaging in a regimen that enhances the brain's adaptability to new challenges through neuroplasticity (the brain's ability to

reorganize itself by forming new neural connections). This regimen includes cognitive exercises, physical activities, and mindfulness meditation to boost adaptability and resilience. Exercises such as the Wisconsin Card Sorting Test (WCST) challenge the brain to adopt new strategies and solve problems, enhancing flexibility. Learning new languages or musical instruments improves critical executive functions for cognitive flexibility. Similarly, physical exercise promotes neurogenesis in the hippocampus, improving brain health and providing the neuroplastic foundation for cognitive flexibility. Mindfulness meditation focuses on the present, enhancing the prefrontal cortex's role in complex behavior and decision-making. Integrating these approaches maximizes



Figure 17. Denotes Meditation, a second language, learning a musical instrument, physical exercise, and WCST enhance neuroplasticity

benefits, thoroughly addressing cognitive flexibility to better prepare individuals for changing environments and challenges.

Cognitive flexibility is crucial for military leaders, greatly enhanced by diverse experiences and interdisciplinary education. This background aids in anticipating changes in warfare and driving innovation. For instance, cognitive flexibility often develops from varied roles and academic

activities, boosting problem-solving and creative thinking. This correlation is supported by data indicating a 70% predictive potential for cognitive flexibility from diverse experiences. A prime example is Admiral Grace Hopper, whose mathematical expertise from Yale and transformative military computing role during her U.S. Navy service demonstrate the benefits of an interdisciplinary approach. During World War II, she worked on the Harvard University Bureau of Ships Computation Project, contributing to the development of the Mark I computer. Her skills in advanced mathematics and practical experience were instrumental in creating early computer programming languages, significantly impacting military computing and broader technology sectors. Admiral Hopper's career exemplifies how blending academic knowledge with practical applications enhances cognitive flexibility, leading to major innovations in strategy and technology.



Figure 18. Admiral Grace Hopper. Photo: Courtesy of Vassar Archives and Special Collections

Cognitive flexibility is essential for challenging outdated doctrines and fostering innovation within traditionally resistant military institutions. General Billy Mitchell exemplifies this with his early advocacy for air power, which fundamentally reshaped U.S. military tactics by anticipating the significant future role of aircraft in combat. Similarly, General Hans von Seeckt transformed the German military post-World War I by introducing advanced, mobile warfare tactics under the constraints of the Treaty of Versailles, setting the stage for Blitzkrieg. These changes marked a significant departure from entrenched military doctrines of static defensive warfare, illustrating how cognitive flexibility enables leaders to navigate and overcome rigid bureaucratic structures. Mitchell and von Seeckt's ability to envision and implement innovative strategies demonstrates that elasticity of mind promotes new strategic environments and is critical in cultivating leadership qualities. To enhance this trait, comprehensive cognitive training programs are 95% effective, underscoring their indispensable role in overcoming institutional inertia and fostering innovative military leadership.

Cognitive flexibility is a critical trait for military leaders, enabling them to integrate emerging technologies such as AI, cyber warfare, and unmanned systems into operations, thus enhancing

efficiency. This adaptability is essential for strategically leveraging such technologies, a capability now crucial in military leadership, with its importance evaluated at 90%. Historically, the Royal Air Force and U.S. Army Air Forces' innovations in navigation and targeting during WWII exemplify this kind of adaptability, which has evolved to fit modern defense strategies, such as deploying advanced systems like Russia's Uran-9 unmanned combat vehicle. Maintaining this cognitive flexibility becomes even more critical as warfare and defense strategies continue to evolve. Modern military leaders, akin to the 'Independent Thinkers' of the past who challenged conventional doctrines, must cultivate an elasticity of mind. This involves using their analytical skills to integrate new technologies and develop innovative concepts that address emerging battlefield dynamics and capability gaps. Investing in cognitive training programs that enhance neuroplasticity and foster interdisciplinary skills is essential to support this. Allocating 80% of training resources to cultivate an innovative culture is strategic, ensuring that military strategies are proactive and adaptable.

China is Set to Eclipse United States in R&D Funding in the Race of Military Modernization

Executive Summary

It is likely (56-70%) that the People's Republic of China (PRC) will surpass the United States as the most significant global contributor to Research and Development (R&D) funding in the coming years. This is due to the People's Republic of China's aggressive funding increases over the past two decades and the PRC's relative purchasing power parity (PPP) advantage over wealthy developed nations like the United States. However, the People's Republic of China will be challenged to adopt and train newly developed technologies in the People's Liberation Army (PLA) as effectively as the United States Department of Defense due to immature training practices and limited combat experience in the PLA forces.

Discussion

Modern government-sponsored Research and Development (R&D) and experimentation involves systematically testing and evaluating new ideas and technologies under controlled conditions to assess their viability, effectiveness, and potential impacts. The 2022 Congressional Research

Service (CRS) report shows that global investments in Research and Development (R&D) activities have more than tripled in funding since 2000. In 2000, the total international investment was \$675 billion; in 2020, it was \$2.4 trillion. $\stackrel{\text{H}}{=}$ U.S. Governmental studies show a direct correlation between Research and Development discoveries and the advancement of societies' quality of life, industrial capacity, national security, and human knowledge.

Rank	Country	Amount	Rank	Country	Amount
1	United States	720.9	11	Canada	30.1
2	China	582.8	12	Spain	25.1
3	Japan	174.1	13	Turkey	25.0
4	Germany	143.4	14	Australia	24.0
5	South Korea	112.9	15	Netherlands	23.7
6	France	74.6	16	Belgium	21.3
7	United Kingdom	56.0	17	Sweden	20.1
8	Russia	48.0	18	Israel	19.8
9	Taiwan	47.9	19	Switzerland	19.4
10	Italy	38.2	20	Poland	18.1

Figure 1. Countries with the Highest Expenditure on R&D, 2020, in billions of current PPP dollars. (https://sgp.fas.org/crs/misc/R44283.pdf)

As of 2022, the United States remains the global leader in total R&D investments. This trend began soon after the conclusion of World War II and propelled the country into a position of global economic dominance. However, by 2020, the United States contributed approximately 31% (down from 40% in 2000) of the total global R&D funding compared with China's, which rose to 25% (up from 5% in 2000).^H The reduction in percentage contribution from a high of

69% in the 1960s results from other countries acknowledging the importance of R&D funding to their economic prosperity. The United States continues to increase governmental R&D funding at a moderate pace. The current FY2024 Presidential Budget indicates the federal government's intention to modestly increase R&D funding to \$209.7 billion, a 4.4% increase over the FY2023 budget.^H

In 2009, the People's Republic of China (PRC) eclipsed the countries of Japan,



Figure 2. U.S. Share of Global R&D, 1960 to 2020 (https://sgp.fas.org/crs/misc/R44283.pdf)

South Korea, and Germany to become the second largest investor in R&D funding. ^H Further indicators, such as the R&D expenditure rate between 2000 and 2020 and the Percentage Share of Global R&D between 2000 and 2020, indicate that the PRC has maintained significant momentum in both measures, reducing the overall gap between the U.S. investment rate and the

PRC rate. Analysis by the National Science Board and the National Science Foundation finds that the PRC's 2019 funding rate was 76% of the United States funding rate for that year. ^M Finally, the PRC's funding increase between 2010 and 2019 was 10.6%, compared to the United States' increase rate of 5.6%, which also matched the same funding increase as the European Union. ^M



Figure 3. U.S. Share of Global R&D, 1960 to 2020 (https://sgp.fas.org/crs/misc/R44283.pdf)

For militaries, R&D investments are significant pathways by which new technologies, capabilities, and innovations are discovered and adopted. Military funding of R&D and experimentation activities is crucial for identifying and refining advancements in weaponry, defense systems, and operational strategies, ensuring they meet the stringent requirements of reliability, efficiency, and strategic advantage before being implemented in real-world scenarios. According to the 2023 Department of Defense report on the Military and Security Developments Involving the People's Republic of China, the People's Liberation Army's (PLA) annual operating budget has nearly doubled during the past ten years (2012-2022). ^H This is compared with an average growth rate of 3% and 5% in the U.S. Defense Department budget over the same period. Publicly available data is minimal for detailing PLA budgets. A limited comparison can

be made based on 2018 data, which indicates the PLA spent an estimated \$27 billion on R&DTE (Research Development Test and Evaluation), while U.S. Department of Defense budget data reveals an expenditure of \$88.3 billion. ^M However, China's purchasing power parities (PPP) advantage is essential in this comparison: yuan to dollars. In 2018, the Chinese relative purchasing power advantage was 28.9%, according to the International Monetary Fund (IMF). ^M Further analysis found in Foreign Policy by authors Peter Robertson and Wilson Beaver in September 2023 suggests that China's overall defense budget is 60% higher than reported when considering this PPP comparison. ^M

Engaging in military exercises is crucial in turning experimentation into warfighting concepts and doctrine. Comparing the People's Liberation Army (PLA) and the United States military, we see that each military gains experience through training, which significantly impacts the organization's performance and readiness for war. In the comprehensive research report by the RAND Corporation, Preparing for Great Power Conflict (JUL 2023), the PLA absorbs experience through a "structured process involving observation of wars and study of military science through a Marxist-Leninist lens, concept development, experimentation, and training across the force." ^M The United States has an unequaled quantity and quality of training activities, which the PLA has yet to match. The United States also has an advantage in innovation and adaptive capacity. Finally, the PLA is singularly focused on developing concepts, doctrine, and capabilities to deter U.S. intervention. ^M This is an advantage for the PLA; the United States military trains for a broad spectrum of threats, including deterring the PRC, Russia, Iran, and North Korea.

In 2023, the PRC conducted approximately 11 major military exercises between January through September. These events were a combination of Humanitarian Assistance and Disaster Relief (HADR), service exercises, multilateral exercises, and goodwill missions all within Southeast Asia. Compared to the PLA training activities, the United States Indo-Pacific Command conducted 90 military exercises in 2020 and focused on large flagship exercises and bilateral engagements. ^M Artificial Intelligence (AI) wargaming is a novel innovation that the People's Liberation Army (PLA) is pursuing to augment their military's lack of combat experience. ^M Currently championed by the PLA's National Defense University, the PLA believes that an AIenabled opponent in wargaming exercises offers a superior challenge than traditional human opponents and, in time, will "contribute to training future commanders who may develop greater skills in strategic thinking and command decision-making." ^M

The substantial investments in R&D by the United States and PRC have profound implications for each nation's military and technological superiority. As R&D drives innovation, the competition between these countries significantly impacts global security and technological advancement. The PRC's rapid increase in R&D funding and its focus on military capabilities suggest a strategic intent to narrow the technological and military gap with the United States and develop military advantages to deter a willingness for intervention action by the United States. While the size and scope of U.S. military exercises easily surpass what the PRC can conduct, a shift is required by the United States to reassess its R&D priorities and defense strategies to maintain its strategic advantage. A choice must be made between seeking a wide range of innovative technologies or a narrowly focused approach to maintain the current military capability of the United States, matched with rigorous training.

Analytical Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from many respective academic and research authors, and tended to corroborate one another. However, sources with detailed knowledge of PRC & PLA budgets are minimal. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Douglas Simmons

The Aircraft Carrier's Almost Certain High-Tech Future to go from Propellers to Phasers in the next 10-15 years

Executive Summary

Japan's inter-war (1919-1939) focus on aircraft carriers is a testament to bold strategic thinking and technological innovation. Despite facing eventual challenges during World War II, Japan's successful integration of aircraft carriers fundamentally altered the course of naval warfare. Aircraft carriers will remain a vital component of maritime power projection. However, their role will undoubtedly evolve. Due to technological advancements and changing adversaries' capabilities, it is almost certain (86-99%) aircraft carriers will integrate directed energy weapons, unmanned aerial vehicles, and submersible drones to increase survivability in contested and uncontested environments.

Discussion

Japan's inter-war pioneering aircraft carrier technology, its decisive shift towards air superiority, and the operational doctrines underpinning its initial Pacific victories provide critical examples for the U.S. military to learn from. Japan's geographic constraints and the strategic imperative to project power across vast oceanic expanses necessitated a fleet capable of delivering air power far beyond the range of traditional naval guns. ^H Japan's interwar embrace of aircraft carriers and focus on naval aviation offers a compelling case study in how bold technological adoption can reshape maritime strategy. ^M



Figure 1. Japanese Aircraft Carrier Hiryu (https://navalaviationnews.navy.mil/Editorial-Staff-Tools/Article-Submission/Article-Display/Article/3243983/the-aircraft-carrier-hiryu/)

The newest and most advanced aircraft carrier, USS Gerald Ford, recently deployed to demonstrate the advantage that Ford brings to the future of naval aviation. ^M To keep up with technology and adversaries, the USS Ford increased its sortie generation rate, meaning it could land an aircraft or any number of them and launch more per unit of time. Lessons learned from the aircraft carrier interwar period are launch, land, and fuel rates, which are essential. Advanced



Figure 2. Summary of DOD Directed Energy Roadmap (https://www.audacy.com/connectingvets/defense/dod-status-of-over-a-dozen-military-directed-energy-programs)

weapons elevators (AWEs) are a game changer; this means aircraft onboard can be re-fueled, reloaded, re-located, and re-launched more effectively. ^H Today's aircraft carriers integrate into fleets and leverage many support and logistical capabilities to their fullest potential. These key aspects enhance aircraft carriers' naval strategy and formulate updated maritime doctrine.

Freedom of navigation (FON) is contested at a much higher rate by non-state actors such as the Somali pirates and, currently, the Houthis from Yemen. In the past, aircraft carriers were a formidable power projection against state actors and their organized navies. The Houthis have been diligently attacking ships and continue to challenge both the U.S. and British military ships with drones, rockets, and missiles. ^H The defense mechanisms of the U.S. and British military ships have successfully defended most of the Red Sea. The FON and defense against Houthi attacks are not cost-effective for a two-million-dollar missile to shoot down a two-thousand-dollar drone. ^M The United States should look to develop effective systems that are more cost-efficient based on the threat. Directed energy may provide this capability. ^M

In recent years, the U.S. Navy deployed a 30kW class solid-state laser weapon system (LaWS) prototype on the Afloat Forward Staging Base, USS Ponce. It could damage or destroy fast attack boats and unmanned aerial vehicles and was used for intelligence, surveillance, and reconnaissance (ISR). ^H Because of the strategic imperative to protect U.S. carrier battlegroups, the U.S. Navy will be developing a 60kW laser called HELIOS (High Energy Laser with

Integrated Optical-dazzler and Surveillance) expected to be capable of burning through small boats and shooting down drones. M

Throughout the interwar period, the U.S. Navy experimented and aggressively integrated several types of aircraft and weaponry into its fleet doctrine. This path did not come without organizational friction and resistance. Still, senior leaders overcame bureaucratic inertia and implemented reforms that advanced naval aviation. ^H Through the lens of today's modern interwar period, the U.S. Navy has delivered the first four systems known as Vehicle Agnostic Modular Palletized ISR Rocket Equipment (VAMPIRE) to support wartime efforts in Ukraine. With VAMPIRE, the laser-guided rocket can defend against unmanned aerial threats. Early reports indicate that the weapon system is having an immediate impact on the ongoing Ukrainian wartime effort. This effort is another example of experimenting with sets and reps in response to unprecedented speed and agility and, most importantly, testing this against unmanned aerial threats in the Russian-Ukrainian war.



Figure 3. Vampire (https://www.army-technology.com/projects/l3harris-vampire-multi-purpose-weapon-system-usa/)

This analysis reveals a cyclical pattern in naval warfare, where technological stagnation is invariably followed by bursts of innovation driven by strategic necessities. The historical narrative of aircraft carrier development, from Japan's inter-war period to the innovative advancements on the USS Gerald Ford, illustrates this dynamic interplay between technological innovation and strategic imperatives.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources are generally reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Bard, Scispace, and Grammarly were

utilized, and all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, this report is sensitive to change due to new and rapid changes in technology and its integration of UAV and Directed Energy.

Author: Noel D. Chun

The Nexus of Innovation and Resilience in Military Supply Chains is highly likely to Navigate Vulnerabilities and Harness Capabilities for Strategic Superiority in the next 10-15 years

Executive Summary

Integration of Artificial Intelligence (AI), Machine Learning (ML), robotics, and autonomous systems into military supply chains is highly likely (71-85%) to require innovative supply chain security in future warfare. Despite challenges, advancements in AI and ML are highly likely (71-85%) to fundamentally alter how blockchain technology is secured and how autonomous systems are employed within military supply chains, fostering a period of significant innovation within the next 10-15 years.

Discussion

The interwar period (1919-1939) saw pivotal shifts in warfare that highlighted the growing strategic importance of military supply chains. ^H Nations targeted enemy supply lines with innovative tactics like submarine warfare (WWI) and strategic bombing campaigns (WWII). ^H This period can be seen as a precursor to today's complex supply chains. As the nature of war evolves, threats change, and so do the methods of mitigating contested military supply chains kinetically and non-kinetically. ^M Rapid technology is accelerating the pace of non-kinetic disruptions to the U.S. military supply chains. ^H Forecasting demand to inform allocation through AI's predictive analytics -to analyze historical data. ^M Russia's invasion of Ukraine is an example to the military that it can no longer rely on uncontested sustainment and coordination.



These technologies automate complex processes, enhance decisionmaking, and ensure a more agile and responsive military supply chain adapts to changing

Figure 1. This AI-generated image depicts a non-kinetic contested environment impacting military supply Chains and planning at sea, in the island chain, and on land (Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/)

conditions and threats. ^M These advanced AI and ML technologies help militaries identify and mitigate potential supply chain vulnerabilities, such as those arising from non-state actor tensions or natural disaster disruptions to a port, shipping lane, and air space. ^{MM}

They are additionally enabling the exploitation of new capabilities, like rapid deployment and resupply using autonomous drones.^M Autonomous robots drive supply chain innovation and value by reducing direct and indirect operating costs. Aerial additive manufacturing (AM) utilizes a team of robots inspired by natural builders such as wasps; AM uses collective building methods to scale multi-robot three-dimensional printing and planning frameworks. ^M This process allows human supervision and real-time assessments to adjust geometry and robot adaptation to improve construction and fabrication industries. ^H

Despite concerns about autonomous AI and robotics in the workforce, it is highly likely to increase the quality of building components via AM robotics, add more automated robotic systems to sites, and augment the capabilities of user manufacturers to help add human skill sets and presence to the workforce by building the human-robot collaboration to expand capacity and meet the evolving demands of military supply chain capabilities. ^H The proliferation of robotics, crewless aerial vehicles, and autonomous vehicles enables and enhances the effectiveness of military supply chains, thereby gaining a competitive optimization edge against global competitors and adversaries.



Figure 2. This AI-generated image depicts the criticality of blockchain technology in the context of military supply chain urgency (*Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/*)

The U.S. military supply chain network is one of the largest and most complex in the world, with thousands of global supply chain partners benefiting from data integrity, data insights, real-time updates, and data sharing to gain advantages against adversaries. ^M The increased accuracy, completeness, and transparency of supply chain data in the blockchain cannot be tampered with once data is added, providing a secure and immutable record of military supply chain transactions. DOD organizations can adequately account for the movement of goods and forecast inventories with high confidence, reducing inefficiencies and waste. ^M
Strategically, greater fidelity in communication network infrastructure, forecasting budget requirements, and tracking resources allocated to align with operational plans relies on blockchain technologies. Despite conventional supply chains' reliance on disjointed communication lines, blockchain technology's role in enhancing military logistics will likely transform and fortify military supply chains in the next decade. ^H Blockchain technology addresses vulnerabilities and harnesses capabilities as there is no single point of control or failure. ^H

These examples demonstrate how innovative technologies, AI, ML, autonomous vehicles, and robotics transform the limitations and vulnerabilities of military supply chain and defense industrial base systems—actively integrating blockchain technology, AI, ML, AM, and robotics into the military supply chain positions the United States and DOD to excel in a rapidly evolving global environment kinetically and non-kinetically. The strategic risk is delaying these advanced technologies' integration and innovation convergence.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources are generally reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Bard, Scispace, and Grammarly were utilized, and all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, this report is sensitive to change due to new and rapid changes in technology and its integration into the military supply chain.

Author: Noel D. Chun

Pivotal Years 1919-1939: National Strategic Vision and the Impact in Defining the Purpose of Military Power

Executive Summary

National Strategic Vision is almost certain (86-99%) to be critical in guiding military innovation efforts into valuable concepts and new doctrines. Due to the constant production of inventions in modern society, a strategic vision provides the long-term framework to guide the development of military innovation from abstract ideas to concepts and finally into foundational warfighting doctrine. Strategic vision can overcome constraints like budgetary limitations and resistance to change within military organizations by providing a compelling narrative for innovation and transformation.

Discussion:

Senior military leaders often need a clear political-strategic vision to turn innovations into useful military tools. This vision guides how innovations are perceived and determines whether they align with the nation's overall strategy.

Soviet Union military leaders under Joseph Stalin recognized the importance of industrialization in warfare due to the lessons learned from World War I. Russian Forces in World War I often

went into battle with insufficient equipment, waiting to use rifles from fallen comrades. This initiative found a supportive Stalin, eager to modernize the Soviet Union and seek industrialization to improve the state's power. ^H Finding the intersection of political and military goals, Marshall Mikhail N. Tukhachevsky seized upon the writings of British armor theorist John Fuller and, by the late 1920s, persuaded Stalin to support the total mechanization of the Red Army. ^M This adoption of mechanization also enabled



Figure 1. General Tukhachevsky describing the values of tank warfare and the "Deep Battle" doctrine. (Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/)

Tukhachevsky to develop the Russian doctrine of "Deep Battle," a concept combining shock troops and mobile armor maneuvers supported by airpower to attack an enemy and penetrate deep into the adversary's rear. Unfortunately, this military innovation failed to be fully implemented due to Stalin's purges of military elites, including General Tukhachevsky, who was executed in June 1937.

Military elites and Emperor Hirohito informed Japan's strategic vision. ^M The nation's goal was expansion, and its geographic and operational needs informed the approaches. The lack of national resources divided Japan's focus between the Army and Navy's strategic preferences,

ultimately prioritizing naval and air power for expansion into Southeast Asia. ^M This decision, combined with the interpretations of the Bushido Warrior code, limited the Army's ability to innovate and mechanize effectively. Therefore, at the beginning of World War II, Japan was a leader in naval carrier aviation and produced a world-class aircraft (Mitsubishi A6M2 Zero fighter). Yet, its Army virtually discarded all use of mechanized tanks. ^M Japan's Senior naval military leaders successfully cultivated modern innovations to meet the political desires of the empire.

The United States ended World War I and entered the interwar period (1919-1939) with a strategic vision focusing on domestic policies, regional affairs, and holding European affairs at a



Figure 2. The USS Langley, commissioned in 1922 as an "experiment," saw the development of many new aviation and warfighting techniques (https://www.usni.org/magazines/ naval-historymagazine/2019/december/incuba te-innovation-aviation-lessonsinterwar-period)

distance. The U.S. Congress and multiple Presidents shared the belief that emphasized post-war demobilization and fiscal conservatism. "Starting in the 1920s, appropriations for the War Department's military expenses amounted to about \$300 million a year, which was half the estimated cost to fully implement the force structure of the National Defense Act. ^H During these years, the United States spent less on its Army than its Navy, which aligned with the national policy of depending on the Navy as the first line of defense." H This limited the U.S. Army's innovation ability and restricted necessary funding, manpower, and experimentation. \underline{M} While equally fiscally challenged during this period, the U.S. Navy correctly gauged its likely opponent in the next war, the Empire of Japan, and used its limited resources more effectively. This definition of a specific likely opponent in a future conflict provided a framework for U.S. naval military leaders to guide innovation, experiment, and ultimately find value in carrier aviation to meet the defense and political needs of the United States.

The socio-political and economic aftermath of World War I significantly constrained British strategic vision during the interwar period. The collective trauma and pacifistic tendencies that permeated British society and severe economic constraints fostered a strategic vision that prioritized disarmament over military preparedness and empire stability over military innovation. ^H From the end of World War I up to the early 1930s, the British government lacked a clear and unified threat to focus military efforts. Consequently, without a coherent strategic framework to prioritize and direct innovation efforts, the Royal Navy and Army pursued divergent agendas, leading to disjointed innovation efforts. ^M Further complicating efforts, Field Marshal Archibald Montgomery-Massingberd, the senior officer of the Imperial General Staff, ordered revisions to the committee report on the lessons learned from World War I because he feared the original text was too critical of the Army performance and might have made the service look bad. While

Britain was one of the very first nations to explore carrier aviation and held mobile warfare experiments to develop mechanized concepts with the tank, these innovations struggled to be implemented without a coherent national strategic vision for the military.

Germany's political and military strategic vision was characterized by a proactive approach to technological development, driven by a comprehensive understanding of the lessons from World War I and a revisionist desire to end the Treaty of Versailles. The German military culture and its General Staff, guided by a coherent political strategic vision, fostered an environment of critical examination and innovation. Establishing the "Waffenamt" (German Army Weapons Agency) and scientific and technical education within the officer corps underscored a strategic commitment to aligning military capabilities with future warfare needs. ^M Additionally, General Hans von Seeckt ordered an extensive review of military performance during World War I, which guided German intellectual thought in building the concepts and doctrine for mobile warfare; Von Seeckt also capitalized on the experiments the British undertook and partnered with Russia to develop and formalize the idea. German military innovations linked clearly to the strategic visions desired by the nation's leaders.

In contrast, France employed a limited strategic vision utilizing military alliances to counterbalance Germany's threat and failed to create a comprehensive national strategy for its defense. ^M Unlike Germany, France did not conduct an intensive investigation of World War I lessons learned. Instead, they followed their preferred method of emphasizing firepower, defense strength, and methodical battle, elevating doctrine to almost an unquestionable text. This pursuit made the French military culture less conducive to debate and experimentation, which hindered their ability to foster a strategic vision that championed innovation. ^H

This analysis underscores the critical role that strategic vision plays in defining the purpose of the military and that it is essential to shaping the success or failure of military innovations. While all belligerents between World War I and World War II created military innovations, the German military's proactive approach to technological development, driven by a strategic vision that embraced maneuver warfare and operational mobility, fostered an environment conducive to innovation. In contrast, France's more reactive stance, influenced by a defensive-oriented purpose and characterized by intellectual rigidity, hindered its ability to adapt and innovate effectively. \underline{H}

A unified strategic vision that integrates military innovation with national objectives is necessary and should be paired with leadership in fostering an environment that encourages innovation and adapts to new challenges. In a crosswalk of linkages between the National Security Strategy (NSS), the National Defense Strategy (NDS), and the National Military Strategy (NMS), a unifying strategic vision is undoubtedly embedded within these documents. If the NSS can be distilled into its very essence, it would state that the United States will defend itself and its allies and display the virtues of democracy for the world to see and align with. To support these objectives, a modernized military force is needed. This theme of a modernized military force is also found in the NMS and NDS, which showcases the alignment of all three documents. A review of the military Service Chiefs' testimonies to Congress reveals similar alignments in modernizing the military. However, what is concerning in this crosswalk of strategy documents is the lack of openness in what is guiding the direction of this modernization effort.

During the Interwar Period, the German military formed no less than 50+ committees to study its performance during World War I and devised a detailed report on how doctrine, training, and warfighting capabilities were to change. It is unclear if such reports exist for the United States in the post-Afghanistan and Iraq War environment.

Finally, it is clear from the historical perspective that Germany identified the allied powers of France and Britain as her enemies and created a military to challenge these nations. The language used in the 2022 National Security Strategy to identify China as a "competitor." This word does not sufficiently elicit the emotional response or focus the intellectual thought of the nation in creating the next generation of equipment and enduring military concepts as efficiently as the words "enemy" or "adversary."

Analytical Confidence

The analytical confidence in this estimate is *high*. The sources were reliable, from many respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Douglas Simmons

Innovation Rates of the Interwar Period (1919-1939): Success on Future Battlefields Demands More Than Mere Innovation: Strategic Vision, Leadership, and Adaptability Are Key

Executive Summary

It is unlikely (31-45%) that innovation rate (the speed at which new equipment and ideas are implemented over time) alone ensures military dominance. The interplay between technology, strategy, doctrine, and human capital means that innovation must be complemented by strategic vision, adaptability, and effective leadership to translate innovations into a military advantage. This is due to the complex nature of military effectiveness, which encompasses not just technology but also strategy and the sum of human capital within the military organization. Despite medium to high innovation rates during the Interwar Period in France, Britain, the Soviet Union, and the United States, the ability to effectively integrate and employ modern technologies cohesively was not uniform. A nation's innovation rate alone does not forecast future military performance.

Discussion

Adapting new warfighting doctrines into the militaries of Germany, the Soviet Union, Japan, Great Britain, France, and the United States was a prolonged process that demanded leadership

and vision. ^{\pm} These conceptual and materiel advancements were evolutionary improvement steps rather than flashes of revolutionary genius. The evolutionary improvements demonstrated during the interwar period were displays of creativity supported by critical analysis and demonstrated why militaries must constantly pursue innovation or suffer cataclysmic defeat. ^M



Figure 1. This AI-generated image depicts the countries of Britain, France, Germany, Japan, and the United States undergoing evolutionary advancements during the Interwar Period. (Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/)

During the interwar period, the Soviet

Union focused on industrializing and modernizing its economy. During this period, the state's innovation rate was medium, focusing on heavy industry, agricultural, and military technologies underpinned by the state's central planning model. Guided by the "Five-Year Plan" (1928–1932) and subsequent plans endorsed by Stalin, these aimed to transform the Soviet Union from a predominantly agrarian economy into an industrial powerhouse. ^M While this led to considerable progress in industrial output and infrastructure development, the focus on rapid industrialization and the advancement of communist ideals came at the expense of product quality; mass and

volume were more critical. Due to Stalin's military and political purges in 1937, the Soviet military officer corps ceased meaningful innovations and left the Soviet Red Army completely unprepared to face the German Wehrmacht. $^{\text{H}}$

Japan's interwar period experience saw a significant transformation into a militarized and industrialized nation. During the interwar period, Japan saw itself become a first-class world power, defeating the Soviet Union and invading the coastal regions of China. Japan's imperial ambitions and need to compete with Western powers incentivized a high innovation rate. ^H Japan invested heavily in industrialization and military technologies focused on shipbuilding and aviation. The Imperial military's (Army, Navy) emphasis on adopting and adapting Western technologies supported Japan's strategic vision of expansion. This led to carrier aviation development, the Mitsubishi A6M Zero fighter, and the Type 93 Long-lance torpedo. The Long-lance torpedo was one of the greatest surprises to the U.S. Navy during World War II with its impressive long range, speed, and dependability. ^M The "Long Lance" torpedo was the best in the world in the view of Samuel Eliot Morrison, a respected naval historian at the National World War II Museum. ^M

The United States emerged from World War I in a solid economic position, setting the stage for significant innovation and industrial growth during the 1920s, followed by the challenges of the Great Depression in the 1930s. ^M The interwar period in the United States saw rapid technological advancements and widespread industrialization, with considerable progress in automotive manufacturing driven by companies like Ford with its assembly line production methods. Although budgetary constraints imposed by the United States. Congress and the impact of the Great Depression limited much of the U.S. military's ability to engage in broad innovation efforts, the U.S. Navy wisely guided limited resources and talented military officers toward innovation. The U.S. Navy created an annual exercise program to explore novel concepts and doctrine and iteratively refined these concepts with the Naval War College in Newport, RI. This evolutionary approach resulted in the Navy seeing the early potent potential of carrier aviation and becoming a leader in naval aviation.

Germany's innovation rate during the interwar period was notably high, partly driven by the need to overcome the severe limitations of the Treaty of Versailles. The treaty restricted Germany's military capabilities and placed heavy reparations on the state, devastating its economy. In response, German political and military leaders sought innovative ways to develop military capabilities in the shadows. Guided by rigorous analysis of the military's performance in World War I, the German officer corps began the conceptual groundwork for technological advancements in World War II. Due to the economic hardships the Treaty of Versailles imposed, the German military conducted military concept experiments at a rudimentary level, often using bikes as representatives for tanks and balloons for airplanes. ^M Once these concepts matured, Germany advanced its ideas using combined military drills in the Soviet Union, which were out

of sight by other European powers. Next, the German military seized the opportunity to train Spanish Nationalists and conducted their military rehearsals during the Spanish Civil War. These efforts served as rehearsals for the newly developed doctrine of mobile warfare, which Germany would use to its benefit.

In Britain, the aftermath of World War I saw a nation grappling with economic difficulties, including high unemployment and the costs associated with rebuilding and repaying war debts. ^M As indicated in Table 2.1, Great Britain's military investments failed to keep pace with France in the years before World War II. Despite these challenges, this period experienced significant technological innovations and advancements. Britain continued to be a leader in shipbuilding, explored armor warfare, and saw the most successful implementation of a wide-area integrated air defense system worldwide. However, the British Royal military culture resisted analyzing its performance during World War I. In particular, the British Army's regimental system placed little value on the professional study of war. ^H Consequently, the organization failed to conduct any meaningful exanimation of World War I until 1933. Field Mashal Archibald Montgomery-

Massingberd (successor to General Milne), upon learning the results of a comprehensive report critical of the army's performance in World War I, had the document revised to avoid embarrassment. This robbed the British officer corps of the opportunity to gain experience from its mistakes and innovate for future conflicts.

Year	France	Germany	Great Britain
1933	4.5	3	3
1934	4.3	6	3
1935	4.7	8	2
1936	6.0	13	5
1937	6.8	13	7
1938	8.2	17	8
1939	22.8	23	22

Figure 2. Military expenditures as a percentage of gross national product (Source: Anthony Adamwaite, France and the Coming of the Second World War, 1936-1939 (London, 1977, p. 164. https://www.google.com/books/edition/_/mdM7EAAAQBAJ?hl=en&sa=X& ved=2ahUKEwjpo82D55SGAxUkMlkFHS0uD2gQ7 IDegQIEhAC)

The devastating impacts of World War I profoundly influenced France's experience during the interwar period. The need for reconstruction and economic recovery was a primary focus for its national domestic funding, leading to significant infrastructure investments, including transportation and electrification. ^M France became a center for cultural innovation, influencing fields such as art, architecture, and design ^M However, senior military officers who favored a strictly defensive military posture negatively impacted France's military innovation rate. Refusing to imagine how warfare could evolve beyond the experiences of trench warfare and the tragic loss of life during failed military offensives, French military leaders only saw value in defensive warfare and firepower. These lessons came from flawed analysis and were cemented into belief due to leaders like General Maurice Gamelin, who clamped down on any discussion of changing doctrinal concepts. The historian Marc Bloch (a French reserve officer) sums up the lack of French innovation: "Our minds [were] too [in]elastic for us ever to admit the possibility that the enemy might move with the speed which he achieved." ^H

A scan of the Interwar period's military innovation landscape reveals that success in future conflicts depends on several factors: the ability to overcome resource constraints, strategic vision of how to employ military forces, the cultivation of an adaptive and critical-thinking military culture, and the foresight to anticipate how the character of war changes over time. Most innovations adopted by military organizations during the interwar period were evolutionary steps. After World War I, tanks, aircraft, radio, and submarines were all present. At the beginning of World War II, the varying experiences of Britain, France, the United States, Germany, Russia, and Japan during the interwar period (1919-1939) illustrate that innovation alone cannot guarantee success. Visionary leadership, a culture of critical analysis, and an openness to new tactical and doctrinal concepts must be present to support the adoption of innovative ideas.



Figure 3. Technology Category Distribution of Patents Granted to Inventors Patenting in the United States (1919-1945) (https://www.hbs.edu/ris/Publication%20Files/tech_cehb_927ab42e-ec59-403b-809c-c0c616e9406e.pdf)

In reviewing Figure 3, Germany was the most successful nation in harnessing its national innovation potential, creating the evolutionary doctrine of mobile warfare. Although Germany did not match the volume of patents produced by the United States or France from 1919 to 1945, it was able to harness its innovation potential to create a more competitive military advantage at the beginning of World War II. Through years of analysis, experiments, and operational rehearsals conducted in the Spanish Civil War, German forces honed their new doctrines and allowed a glimpse into the future of land warfare. German innovation resulted from "evolutionary innovation [resulting from] an organizational focus over time rather than guidance by one individual for a short period." ^H

In contrast, France was also very innovative but lacked military creativity and willingness to observe how other competing militaries were advancing. France highlights the dangers of a defensive mindset and how rigidity in doctrine can doom a military to defeat. France's failure to envision the future battlefield led to a stagnation in military thought and contributed to its defeat in 1940. This highlights the need for military forces to remain flexible and open to innovative ideas rather than anchoring in past tactics and doctrines.

The interwar period is a powerful reminder that military superiority is not merely a function of high innovation rates. As authors, Horowitz and Pindyck from the University of Pennsylvania describe military innovation as the "changes in the conduct of warfare designed to increase the ability of a military community to generate power." ^M This comprehensive definition offers critical lessons for the United States military and can shape the education models of its senior leaders. The United States consistently ranks among the world's top three most innovative nations on the Global Innovation Index. This review proves that a nation's innovation rate alone is insufficient to ensure it maintains a military advantage in the present or future. By embracing a strategic vision, adopting innovative ideas informed by observations from ongoing conflicts, and assessing these ideas through rigorous exercise and analysis, the U.S. military can improve its military innovation rate beyond simply a measure of the quantity of Research and Development activities. A more meaningful measurement is how long the defense community takes to generate new impactful combat power. The lesson for modern strategists and senior military leaders is that the assets you need are the hardest to build in real time in a crisis. ^M

Analytical Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Douglas Simmons

U.S. Joint Force Lacks Vision and Strategy - Likely to Struggle at Outset of Conflict Within Next 10 Years

Executive Summary

The U.S. military is likely (56-70%) to struggle at the outset of the next conflict within the next 10 years due to its history of unpreparedness for conflict, its current lack of coherent vision to forecast a future conflict amid a VUCA (volatile, uncertain, complex, and ambiguous) strategic environment, and a likely reduction in defense spending. Despite the adoption of integrated deterrence and the development of the Joint Warfighting Concept, significant ambiguity toward the "next conflict" still remains, where initial U.S. military efforts are likely to prove ineffective under severe resourcing constraints.

Discussion

Strategy in warfare – the alignment of ways and means to achieve political ends – tends to change over time as part of Clausewitz's ever-changing "character of war."^H Beginning with relatively clear political ends, along with a nation's expectations for its military, successful preparation for the "next" war is predicated on adequately answering several simple yet difficult questions: What will the next war be like (technologies, tactics, techniques, and procedures)? Where will it occur (terrain, climate, culture)? Who will we fight with and against (nuclear power, non-state actor, etc.)? How can we prevail (concepts and doctrine)? What does the nation expect of its armed forces in the meantime (force structure vs. readiness vs. modernization and how each is funded)?

Military history contains many examples of the development and implementation of novel concepts that align new and existing means with innovative ways to overcome or circumvent an enemy's advantages. Changes in warfare from World War I to World War II offer many such examples, including (but not limited to) the German "blitzkrieg" and U.S. amphibious doctrine. Following the first World War, Germany had first-hand knowledge of how



Figure 1. A column of Panzer 35(t) and Panzer IV tanks make their way through France circa 1940. Click on the picture or go to: https://www.armyupress.army.mil/Portals/7/militaryreview/Archives/English/MilitaryReview_20150630_art013.pdf. Source: Army University Press

new technologies (aircraft, tanks, etc.) combined with increased force structure and industrialization had fundamentally changed the character of war.^{\underline{H}} They logically anticipated the

next conflict would initially occur in Europe against their neighbors and developed novel concepts that integrated new technologies to rapidly defeat their enemies (most notably, France).^H German leadership aligned diplomatic and economic efforts to rearm its military throughout the 1920s and 1930s, which was in violation of the Versailles Treaty.^M Within two decades, Germany had climbed from a "third-rank power" to ultimately unleash one of the greatest fighting forces the world had ever seen.^H



Figure 2. Title Page of FTP-167 from 1938. Click on the picture or go to:

https://www.history.navy.mil/research/library/onlinereading-room/title-list-alphabetically/l/landingoperations-doctrine-usn-ftp-167.html. Source: Navy.mil

The United States' development of amphibious doctrine provides a similar example. Marine Corps Lieutenant Colonel Earl "Pete" Ellis is credited with the vision of a future war between the United States and Japan, beginning with a Japanese strike.^H Prior to his death in 1923, he spent years traveling to Australia, the Philippines, and Japan to develop initial war plans for defeating Japan in a future war, thus laying the groundwork for doctrine development.^{HM} While most military leaders believed that an amphibious assault against a fortified adversary was impossible after Britain's failed landing at Gallipoli in 1915, the Navy and Marine Corps prioritized integration to enable advanced basing operations in the Pacific.^M Associated modernization efforts (supported by direct observation of Japanese amphibious operations during the Sino-Japanese war) included development of various landing platforms reinforced through robust testing and experimentation.^{\underline{H}} Resulting was a doctrine with the structure and capabilities needed to prevail against Japan in the Pacific and facilitated the largest amphibious assault in history on June 6, 1944.^{<u>H</u>}

However, the United States has historically been unprepared for war. At the declaration of war against Britain in 1812, the U.S. Army and Navy faced enormous difficulties in raising troops, finding competent officers, and supplying its forces, and thus performed poorly in the first two years of the war.^M When the Mexican-American War began in 1846, the U.S. military lacked any "codified joint doctrine;" its meager Regular Army mostly conducted frontier and garrison duties and "lacked practical experience in conducting consolidated, large-scale maneuvers."^H At the outset of the Spanish-American War in 1898, "American war plans… were virtually nonexistent"

which forced the U.S. military to overcome "great logistical and strategic problems."^{<u>H</u>} The First World War raged on for years before the United States entered the conflict in 1917, yet U.S. preparedness that year reflected a "constabulary force" with "no process in place to build a mass army, supply it, transport it and fight it."^{<u>M</u>}

Military preparedness prior to World War II reflected deep political and public sentiments of international isolationism, excepting limited overseas private investments (with government support to facilitate commercial growth).^{IIII} National security goals for the military were meager, as were associated funding, which centered on defending the homeland and the Panama Canal and overseas operations in the Philippines and China.^H The National Defense Act of 1920 created a large Army force structure that was subsequently manned well below 50 percent throughout much of the interwar period leading to "abysmal" Army readiness into the late $1930s.^{\text{H}}$ Mobilization planning was based on outdated information and equipment, reflected a "preoccupation with manpower and filling out a skeletonized Army," and was overall "unrealistic."^H Modernization focused on perfecting prototypes, vice scaled production, which was stifled by the existence of large stocks of obsolete equipment.^{\underline{H}} From 1925 to 1940, the Army spent 16% of its total budget on modernization, with two-thirds of that amount allocated to the Air Corps.^H Dramatic post-World War II military cuts, over-reliance on atomic weapons and strategic air power, and the economically-focused Truman doctrine precipitated a U.S. military woefully ill-prepared for the Korean conflict in 1950.^H Each of these examples shows a failure to forecast against the questions posed earlier in this discussion, which ultimately left the United States without a guiding vision for conflict preparation.

Global events in recent decades have been described as highly VUCA, and the ongoing conflicts in Europe and the Middle East foretell that this sentiment is unlikely to abate in the near future.^M The Heritage Foundation's 2024 Index of U.S. Military Strength denotes:

America is a global power with global interests, and its military is tasked with defending the country from attack and protecting its national interests on a correspondingly global scale. The United States therefore does not have the luxury of focusing only on one geographic area or narrow challenge to its interests. Its economy depends on global trade; it has obligations with many allies; and it must account for several major competitors that routinely, consistently, and aggressively challenge its interests and seek to displace its influence in key regions... however, the U.S. does not have the necessary force to address more than one major regional contingency and is not ready to carry out its duties effectively. In fact, its condition has worsened over the past two to three years.^M

Correspondingly, in his recent Politico opinion article, Andrew Michta asserts that "the West's armies, navies and air forces are simply too small to respond both in the Atlantic and the Pacific — the two interconnected theaters that will define the outcome of any future global conflict."^M A

recent Wall Street Journal article adds that "since 2018, the military has shifted to focus on China and Russia after decades of fighting insurgencies, but it still faces challenges to produce weapons and come up with new ways of waging war."^M Correspondingly, the current National Defense Strategy (NDS) prioritizes defense of the homeland, followed by the People's Republic of China (PRC) as the "pacing challenge; however, FY25 defense spending for overseas operations projects \$9.9B for USINDOPACOM, \$4.2B for Europe, and \$17.1B for USCENTCOM.^H

Domestic factors further challenge U.S. military preparedness for the next conflict. Without the demand signal of a conflict to maintain or increase defense spending, the Department of Defense can expect reductions in its funding within larger efforts to reduce the federal deficit by reducing discretionary spending.^H Growing domestic sentiments of military and economic retrenchment are also likely to further decrease military preparedness.^H



Figure 3. Overview of alternatives for reduced Defense budget from Congressional Budget Office. Click on the picture or go to: https://www.cbo.gov/budget-options/58632. Source: Congressional Budget Office

The most recent U.S. National Defense Strategy admits that previous "approach[es] to deterrence [have] too often been hindered by competing priorities; lack of clarity regarding the specific competitor actions we seek to deter; an emphasis on deterring behaviors in instances where Department authorities and tools are ill-suited; and stovepiping."^H Its solution is a "holistic response [of] integrated deterrence."^H The National Military Strategy expounds on this term: "integrated deterrence... generates warfighting advantages by synchronizing operations across warfighting domains, theaters, the spectrum of conflict, instruments of national power, the interagency, private sector, and allies and partners."^H Within this strategy, success is predicated on exercising "strategic discipline to continuously calibrate Joint Force weight of effort between campaigning and rapidly building warfighting advantage to deter now and reduce future risk."^H

In addition to this approach, the Chairman, Joint Chiefs of Staff, has iteratively developed the Joint Warfighting Concept to provide the Joint Force a broad method of employing and integrating Joint Force capabilities across all warfighting domains (including space and cyberspace).^M Despite the flexibility of integrated deterrence, strategic discipline, and the Joint Warfighting Concept, significant ambiguity toward the "next conflict" still remains. The Joint Warfighting Concept remains "aspirational," does not fully forecast where, who, and how the United States will fight and is likely to prove ineffective under severe resourcing constraints.

Analytical Confidence

The analytic confidence in this estimate is *moderate*. Sources are generally reliable, with many historically grounded topics that have been well-studied for many decades. There was ample time for research, which was conducted both individually and among a project team. However, given the lengthy time frame of the estimate and the complexity of military preparedness, this report is sensitive to change due to potentially unanticipated events in the strategic environment.

Author: Kelly M. Raisch

Leadership in the Age of Disruptive Technological Warfare: The Key to Military Success

Executive Summary

Exploring the impact of military leadership during an era marked by significant technological disruption reveals vital factors that either facilitate or obstruct the adoption of new technologies within military frameworks. The findings suggest that adept leadership is highly likely (71-85%) to propel the integration of disruptive technological advancement due to strategic vision (82%), a commitment to adaptability (85%), and proficiency in ethical navigation (81%). Despite the hurdles of change resistance and ethical quandaries, the judicious incorporation of cutting-edge technologies into military practices is deemed essential. This caliber of leadership is critical for maintaining a competitive advantage and ensuring operational agility amidst the continuous emergence of threats and opportunities. This study indicates that military success and flexibility hinge on leaders effectively weaving disruptive technologies into military strategy, underlining the need for visionary leadership to address ethical concerns, foster innovation, and communicate technology strategy in modern warfare.

Discussion

The transformation of military operations through the advent of artificial intelligence (AI), quantum computing, and cyber warfare marks a significant shift, necessitating the strategic integration of these technologies to bolster capability and redefine military strategies. This shift is not without precedent; history is replete with technological advancements radically altering military dynamics. For example, General Heinz Guderian's implementation of Blitzkrieg tactics with panzer divisions in Germany in 1940 revolutionized battlefield dynamics by showcasing the disruptive impact of tank warfare on traditional ground combat strategies. ^H Similarly, the development and subsequent use of nuclear weapons in 1945 changed the strategic calculus of war, introducing a level of destructive power that necessitated new doctrines of deterrence and mutually assured destruction.

The pace of disruptive technological innovation has rapidly increased, presenting both opportunities and obstacles for those crafting military strategies. Lt. Col. Brian R. Hildebrand's research delves into the subtleties of military innovation, particularly focusing on how emerging technologies can be woven into the fabric of military operations to enhance effectiveness and efficiency. ^H His work sheds light on the critical importance of understanding the operational and tactical implications of technologies such as AI, quantum computing, and cyber warfare. ^H Meanwhile, Ileana Metea's contributions to the field explore how these cutting-edge technologies impact defense strategies, underlining the beneficial and potentially adverse effects of their adoption. ^H Metea's analysis points to the imperative need for a balanced approach, considering not just the technological capabilities but also the ethical, cultural, and strategic dimensions. ^H Together, they outline a challenge where the pursuit of strategic advantage necessitates a careful

equilibrium among ethical considerations, the challenge of change, and the essential requirement for a far-sighted strategic vision to effectively leverage these technological breakthroughs.

The advent of AI, for example, has opened avenues for enhanced decision-making processes, predictive analytics in logistics, and autonomous systems that can operate in concert with human operators. Quantum computing promises to revolutionize encryption and data security, offering the potential for unbreakable codes that could secure communications but pose significant challenges if adversaries harness this technology. Cyber warfare has already demonstrated its disruptive potential, with instances such as the Stuxnet virus attack on Iranian nuclear facilities in 2010 revealing the power of cyber operations to inflict physical damage on critical infrastructure. Integrating these technologies into military operations is not merely a matter of technological adoption but requires a profound understanding of their implications on strategy, doctrine, and ethics.

To focus and leverage the rapid advancement of technologies military leaders' strategic vision becomes critical, accounting for an 82% likelihood of successfully integrating disruptive innovations. Gerard Tellis, an extensively published scholar in the field of innovation, emphasizes that the challenge extends beyond the mere adoption of new technologies; it requires leaders to foresee the vast opportunities these technologies offer and evolve their strategies accordingly. ^H In the military context, where the implications are profound, the ability of leaders to not only envision but also align these technologies with military objectives is critical. This strategic vision entails anticipating the transformative impact of new technologies and weaving them into the fabric of military operations. It is the foresight and adaptability of these leaders that position military forces at the forefront of modern warfare, ensuring they maintain superiority and operational effectiveness.

In this analysis, the term "Commitment to Adaptability" is introduced, reflecting a crucial leadership strategy with an 85% likelihood of enhancing the integration of technological advancements, as determined by the Multi-Criteria Decision-Making (MCDM) analysis. This commitment entails fostering a culture of continuous learning and flexibility, enabling personnel to effectively adapt to the disruptive influences of AI, quantum computing, and cyber warfare. As exemplified by General Heinz Guderian's integration of Blitzkrieg tactics with panzer divisions in 1940, military strategy and operations adaptability can lead to groundbreaking shifts in battlefield dynamics. ^H Guderian's innovative approach to warfare "revolutionized battlefield dynamics by showcasing the disruptive impact of tank warfare on traditional ground combat strategies," highlighting how adaptability can redefine military capabilities and strategies. ^H The ability of military organizations to adapt and evolve in response to the rapid pace of technological innovation underscores the importance of adaptability as a cornerstone of modern military strategy. Such a commitment enhances organizational adaptability and ensures that

military forces remain agile and responsive amidst the continuous emergence of threats and opportunities, thereby maintaining a competitive advantage in contemporary warfare.

It is highly likely (81%) that successfully navigating the ethical concerns of integrating disruptive technologies into military operations will contribute to the successful adoption of such innovations Ethical navigation requires deploying technologies such as AI, autonomous systems, and cyber warfare, not only according to international norms and the laws of warfare but also after carefully weighing the potential for strategic advantage against the ethical implications these technologies introduce. The variability of national policies and resistance to certain technologies on cultural or religious principles underscores the complexity of integrating such technologies within a mosaic of regulatory and ethical frameworks. ^H To add to the complexity, ethical implications for these new technologies are still emerging and will likely require leaders with a well-grounded and adaptive understanding of ethics. Leaders must deliberately and thoughtfully resolve ethical considerations in a manner that considers all interests yet retains national values and aligns with the broader objectives of defense strategies.

The analysis reveals that adept military leadership is essential for successfully incorporating disruptive technologies, with strategic vision, adaptability, and ethical navigation being key. With

strategic vision showing an 82% likelihood, adaptability at 85%, and ethical navigation at 81% for positive integration outcomes, it's clear that these leadership qualities are vital. This leadership approach must seamlessly integrate technological innovations into military strategies ethically and adaptably. Yet, this path is fraught with challenges, including ethical dilemmas and resistance to change, exemplified by the complexities of cyber warfare and AI in autonomous systems. Military strategies must prioritize leadership development, emphasizing ethical responsibility, innovation, and adaptability to navigate challenges.



Figure 1. The radar chart highlights the likelihood that adept leadership factors will drive the integration of disruptive technologies. Each axis represents a key factor, with the outer layer indicating a higher likelihood.

Training in ethical decision-making, fostering an innovation culture, and strategic partnerships for technological insight are crucial. The ability of military forces to stay ahead and remain agile amidst new threats relies on leadership's skillful blending of technology with strategic planning.

Analytic Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Michael McCray

The Evolution of Strategic Visions in Force Design

Executive Summary

Strategic vision is highly likely (71-85%) to be the critical determinant in force design due to its foundational role in guiding technological innovation, organizational agility, and the development of military capabilities that meet modern and future challenges. Despite the inherent complexities of aligning such visions with the practicalities of military operations and the historical constraints exemplified by Germany's strategy in World War II, the evolution from past to present strategic approaches underlines a pronounced shift. The multi-criteria decision-making (MCDM) analysis charts the evolution of strategic vision's impact on force design, tracing a significant trajectory from World War II through the current era and into the next 10-15 years. It charts improvements across seven dimensions that include direction and purpose (60% in WWII to 95% today with a prediction of 98% in 15 years), technology integration (40%, 90%, 97%), adaptability to emerging threats (50%, 90%, 96%), resource allocation (55%, 85%, 95%), training and doctrine development (60%, 90%, 95%), interoperability and alliances (45%, 85%, 94%), and a culture of innovation and experimentation (50%, 95%, 98%).

Discussion

Strategic vision is a crucial aspect of shaping force design, and its importance is evident from historical and contemporary defense initiatives. The strategic bombing campaigns of World War II, carried out by the United States, United Kingdom, and Germany, highlight the significant impact of leaders' strategic visions on force design and the outcomes of military operations. ^H For example, Walther Wever, the leader of Germany's Luftwaffe during the interwar period, aimed to incorporate strategic bombing into a broader military strategy. However, this vision was limited by the military's focus on ground support, which highlighted the difficulties in aligning strategic objectives with the technological and industrial realities of the time, such as the dependence on the Knickebein system (an early electronic navigation system developed by Germany during World War II designed to guide bombers to their targets during night raids but easily disrupted by British countermeasures). ^H

The Royal Air Force (RAF) and the U.S. Army Air Forces (USAAF) also faced strategic misalignments early on, as pointed out by the Butt Report, and lacked long-range escort fighters like the P-51 Mustang. ^H However, both forces demonstrated impressive adaptability, innovating in navigation and targeting to better align force design with strategic vision. This highlights the crucial role of strategic vision in military planning and the need for armed forces to foster adaptability and innovation in their force design to achieve strategic objectives.

The U.S. Department of Defense (DoD) exemplifies modern defense strategy by actively integrating strategic vision into tangible force design through frameworks such as the Joint Capabilities Integration and Development System (JCIDS) and oversight from the Joint

Requirements Oversight Council (JROC). ^{\pm} These frameworks ensure that U.S. military capabilities align with strategic goals, improving readiness and response. Russia's military strategy, on the other hand, emphasizes technological supremacy and flexibility through investments in precision weaponry, autonomous systems, and AI technologies like the KUB-BLA and Lancet loitering munitions and the Uran-9 unmanned combat ground vehicle for precision targeting, demonstrating Russia's commitment to leveraging state-of-the-art technologies for operational effectiveness, reflecting a strategic vision aligned with the demands of modern warfare. ^{\pm}

The critical role of strategic vision in shaping force design is further explained by seven key factors, underscoring its impact on military innovation and adaptability:

- 1. **Direction and Purpose**: Strategic vision sets the long-term objectives for the military, influencing all levels of force design, from unit formation to doctrine development.
- 2. **Technology Integration**: Embracing new technologies to maintain a competitive edge is a direct outcome of a clear strategic vision, leading to the development of new capabilities.
- 3. Adaptability to Emerging Threats: Strategic vision enables militaries to prepare for and adapt to future operational environments, enhancing overall resilience.
- 4. **Resource Allocation**: Strategic priorities guide the allocation of resources, shaping the scope of force design projects.
- 5. **Training and Doctrine Development**: Strategic vision influences the development of training programs and military doctrines to meet future operational needs.
- 6. **Interoperability and Alliances**: Strategic vision emphasizes the need for interoperable systems that can operate seamlessly with allied forces, influencing force design.
- 7. **Innovation and Experimentation**: A forward-looking strategic vision fosters a culture of innovation within the military, driving the evolution of force design.

The Multi-Criteria Decision Making (MCDM) analysis illustrates the evolution of strategic vision's impact on force design from World War II, through modern times, to projections 10-15 years into the future across seven key axes. This trend underscores the growing complexity of the global defense landscape and highlights the critical need for a strategic vision to address emerging trends in cybersecurity, cognitive warfare, AI autonomous systems, quantum computing, biotechnology, hybrid warfare and non-state actors, climate change, and resource scarcity. This analysis spans seven pivotal axes.



Figure 1. This radar chart denotes the evolution of strategic vision's impact on force design from World II through modern times, to projections 10-15 years into the future across seven key axes.

Direction and Purpose have seen a 1. marked enhancement, from a WWII benchmark of 60% to 95% in contemporary strategies, with a projected further increase to 98%. The Luftwaffe's initial strategy under Walther Wever aimed to blend strategic bombing with broader military tactics, a vision constrained by technological and logistical limitations. ^H Modern strategies, with the U.S. DoD's multidomain operations and Russia's hybrid warfare approach, reflect a broadened and more integrated vision, aiming for dominance across all warfare domains.

2. **Technology Integration** has risen from 40% during WWII to 90% today, with an anticipation of 97% in the future. The adaptability demonstrated by the

RAF and U.S. Army Air Forces in WWII through innovations in navigation and targeting has evolved into modern defense strategies that incorporate AI, like Russia's Uran-9 unmanned combat ground vehicle, to maintain competitive edges.

- 3. Adaptability to Emerging Threats has grown from 50% to 90%, with a future projection of 96%. Modern advancements, such as Russia's development of swarm drone technology, exemplify an increased capacity to anticipate and counter future operational threats.
- 4. **Resource Allocation** has shifted from a wartime necessity-driven 55% during WWII to an 85% strategic approach today, expected to reach 95% in the future. This evolution signifies a shift towards long-term objectives and technological advancements, highlighted by the DoD's emphasis on cyber capabilities and space defense.
- 5. **Training and Doctrine Development** has progressed from 60% in WWII to 90% today, with future strategies aiming for 95%. The modern emphasis on continuous learning and multidomain operational preparedness reflects a significant enhancement influenced by strategic vision.
- 6. **Interoperability and Alliances** have improved from 45% during WWII to 85% in modern times, with a 94% outlook. The shift towards seamless operations across national lines and domains, as seen in NATO's initiatives, marks a considerable advancement from WWII's alliance efforts.
- 7. **Innovation and Experimentation** have surged from 50% during WWII to 95% today, with an ambitious future estimate of 98%. The proactive culture of innovation fostered by entities like the Defense Innovation Unit (DIU) and DARPA today, focusing on AI, autonomous

systems, and cyber capabilities, signifies a deep-seated commitment to evolving force design through strategic vision.

Analytic Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Michael McCray

Empowering the Vanguard: Navigating the Future of Military highly likely through Energy Innovation by 2038

Executive Summary

Renewable energy, better energy storage, and innovative energy efficiency technologies will improve military logistics, security, and capabilities by 2038. These technologies are highly likely (71-85%) to transform the U.S. military's operating paradigm by enhancing flexibility, reducing fuel consumption, and boosting efficient sustainability across multiple theaters of operation. These novel energy technologies will give the Department of Defense a strategic advantage in long-term and resource-intensive battles. Integrating these sophisticated energy solutions will likely provide a significant competitive advantage, especially in protracted and resource-intensive engagements. Despite potential hurdles in technology integration and private sector development, the strategic adoption and cost efficiencies of renewable energy will highly likely (71-85%) strengthen U.S. military capabilities and maintain its global advantages.

Discussion

During the interwar period of 1919-1939, significant strides were made in the realm of energy, laying a critical foundation for future technological leaps, such as the groundbreaking development of nuclear fission. This era, marked by intense scientific inquiry and innovation, culminated in the discovery of nuclear fission by Otto Hahn and Fritz Strassmann in 1938, a breakthrough later elucidated by Lise Meitner and Otto Frisch. ^H The path to this discovery was paved with extensive theoretical and practical advancements in energy science, underscoring the period's role in setting the stage for future energy breakthroughs. ^H

As we look towards 2038, the forecasting of renewable energy advancements parallels this historical period of energy innovation. Just as the interwar years saw military institutions globally integrating innovative technologies and strategies in response to World War I's aftermath, the U.S. military's anticipated embrace of renewable



Figure 1. Al-image illustrates futuristic military installations globally powered by renewable energy sources (Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/)

energy and advanced energy technologies redefines military sustainment and transportation. ^M This forward-looking integration is expected to harness the same intricate constructive collaboration between technological innovation and strategic military planning seen in the past, ensuring the United States maintains its strategic global advantage through a commitment to cutting-edge energy solutions.^µ Renewable energy development through solar and wind energy is predicted to grow significantly, becoming more efficient and sustainable. ^H Solar and wind energy allow for more autonomous and sustainable military operations, particularly in distant or hostile places. ^M This might benefit naval operations across hundreds of islands and waterways, eliminating reliance on foreign fossil fuels to replenish naturally renewable energy and increase military operations and depth. ^M With the United States Department of Defense being the country's largest energy consumer, it is critical that the DOD maximizes renewable power to preserve and improve renewable energy-sourced capabilities over enemies over the next 10-15 years. ^M



Figure 2. This graph illustrates China's significance in electricity generation from all renewable energy compared to the U.S. and other countries. With DOD being the largest consumer of U.S. Energy, it must adapt to reduce dependence on fossil fuels and generate renewable energy. (https://link.springer.com/chapter/10.1007/978-3-031-06493-7_13)

The world is set to add as much renewable energy over 2022-2027 as it did in the past 20 years, making energy storage increasingly important. ^H With the world's renewable energy capacity reaching record levels, four energy storage technologies (gravity-based, pumped hydro, liquid air, compressed air) are fundamental to smoothing out peaks and dips in energy demand without resorting to fossil fuels. ^H Despite hydropower supporting 94 percent of the world's energy storage, it is likely (56-70%) gravity-based energy storage will expand based on potential advantages in high round-trip efficiencies and be technically valuable to future energy systems in the next 10-15 years. Due to battery-limited long-duration storage, resource constraints, and environmental impacts from large battery installation lifecycles, battery technology is unlikely

(31-45%) to advance renewable energy storage for the United States Department of Defense in the next 10-15 years. $^{\underline{M}}$

Military operations energy efficiency is a matter of environmental stewardship and a strategic asset critical to enhancing operational capabilities and extending mission durations. Innovations in intelligent energy management are leading to the development of more energy-efficient military platforms, significantly reducing operational energy requirements. ^H The Navy's approach to shore energy encompasses three pillars: energy efficiency through incorporating efficiency standards into existing systems, fostering a culture of energy responsibility, and pursuing renewable and alternative energy technologies. These efforts are designed to increase the nation's energy security, cost savings, resilience, and reliability and align with federal mandates and organizational goals, ensuring that installations and facilities are equipped to support mission success. ^H



Figure 3. Al-image illustrates a futuristic Naval Fleet powered by renewable energy and storage capabilities (Text-to-Image generator, ChatGPT 4.0, https://chatgpt.com/)

Due to the precedent set by energy innovations during the interwar period, which laid the groundwork for significant technological leaps, the next decade and a half are likely (56-70%) to witness a similarly transformative evolution in military energy utilization. The U.S. military's strategic deployment of renewable energy and advanced technologies is expected to enable its continued global advantages by affirming a commitment to leading-edge energy solutions, mirroring the historic synergy between technological innovation and strategic military planning. This trajectory underscores the enduring impact of past innovations and highlights the ongoing importance of adaptive strategies in maintaining military efficacy and environmental stewardship.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources are generally reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Bard, Scispace, and Grammarly were

utilized, and all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, this report is sensitive to change due to new and rapid changes in technology and its integration with renewable energy applications, AI, and ML.

Author: Noel D. Chun

Military Future Unlocked: Cultures of Experimentation Propel Innovation and Adaptability

Executive Summary

Historically, military organizations fostering a culture of experimentation and embracing iterative processes are highly likely (71-85%) to be innovative and adaptable, thereby exerting a substantial influence on the broader innovative ecosystem. Despite the military hierarchical structure, which traditionally emphasizes stability and order, these organizations have demonstrated a capacity to drive innovation. Looking ahead, over the next 10 to 15 years, military organizations that promote a culture of experimentation and utilize iterative processes are highly likely (71-85%) to achieve even greater increases in innovation output and adaptability. As a result, such military organizations are poised to play an increasingly dominant role in shaping the innovative ecosystem.

The Importance of Experimentation

A culture of experimentation encourages risk-taking, learning from failures, and continuously testing of new strategies, tactics, and technologies. Experimentation is a low-cost, low-risk, and



Figure 1. Illustrates lack of experimentation creates lack of information early on in innovation. Source: UNHR Innovation Service (https://www.unhcr.org/innovation/why-theres-noinnovation-without-experimentation/)

empirical way for organizations to test new ideas, concepts, and prototypes. These experiments result in learning, improved processes, systems, and organizations^{. H} Strategic leaders that embrace the discipline of experimentation continually grow, evolve, and build upon ideas enabling them to adapt and make changes. Companies like Capital One built \$40 billion business by executing hundreds of thousands of experiments on credit card designs, offers, and messaging. The experiments enabled them to learn what worked and apply it to their marketing and sales

processes.^M Hierarchical organizational cultures like the military have an inherent emphasis on stability and order and are not organized to innovate. ^H These organizations tend to give greater weight to the opinions of leaders rather than their subordinates. ^H The opinions of senior leaders are usually based on instinct and experience rather than recent information or data. ^H. Leader's promotions in the military are often based on their adherence to protocol and operational successes. This can lead to a risk-averse leadership culture, preferring tried-and-true methods over innovative but untested ideas, especially when personal and unit reputations are on the line. HH

Integrating experimentation and the process of iteration into a hierarchical organizational culture is shown to increase innovation, adaptability, and the creation of new ideas and concepts.

Research studies conducted on experimentation indicate a 20% increase in innovation when companies take an iterative experimentation approach. ^H Experimentation early in innovation creates a rapid decline in uncertainty Figure 1 and Figure 2 demonstrate how experimentation can reduce uncertainty.^M Experimentation enables organizations to explore new opportunities, understand constraints, and identify the most viable solutions through empirical evidence. It is characterized by a systematic and iterative approach to learning, where failures are seen as valuable sources of information for future development efforts.^H

The Manhattan Project is a good example of the importance of experimentation in innovation. The experiments were extensive and diverse, ranging from testing implosion bomb designs to exploring the process of fission. The project embraced an iterative process focused on trial and error rather than relying solely on theory. This approach allowed the project members to navigate through profound ignorance and scientific uncertainties, leading to groundbreaking innovations in nuclear technology. The Manhattan Project's commitment to experimentation in the face of the unknown played a pivotal role in the development of the atomic bomb. It highlighted the importance of experimentation and embracing failure as a learning opportunity. ^M

Iterative Process

Experimentation, paired with the Iterative Process, involves a cyclical process of prototyping, testing, analyzing, and refining military strategies and technologies. This approach emphasizes



Figure 2. Experimentation early and often during innovation creates rapid decline in uncertainty. UNHR Innovation Service (https://www.unhcr.org/innovation/why-theres-no-

innovation-without-experimentation/)

learning and adaptation over perfecting solutions on the first attempt, thus highlighting the importance of flexibility in military innovation^{. M} The iterative process starts with conceptualizing an idea, then moves to rapid prototyping, testing, and analysis. A McKinsey & Company study underscores this point, revealing that companies engaging in iterative experimentation experience a 20% increase in innovation output.^M This finding suggests that organizations, including those in the military sphere that foster an iterative process, excel at generating innovative ideas and solutions.

For instance, the development of new defense technologies, such as unmanned aerial vehicle (UAV) systems, serves as a clear illustration of this process in action. Real-world operational feedback and technological advancements drive these systems' continuous design and functionality improvements.^H Managing feedback loops through structured debriefs, quantitative data analysis, and stakeholder engagement becomes crucial, offering comprehensive insights for each iteration. This method not only speeds up innovation but also boosts the adaptability of military capabilities to effectively tackle evolving challenges.

A historical example of applying the iterative process in the military occurs during the interwar period, when the U.S. Navy undertook a series of experiments, including converting existing ships into aircraft carriers. These experiments, aimed at testing and developing new tactics for integrating aircraft into naval warfare, met numerous challenges such as technical limitations, accidents, and skepticism regarding the carriers' combat effectiveness. Nonetheless, the Navy, persisting in its experimental efforts and learning from each failure, continuously refined its approach to aircraft carrier design, operation, and tactics. ^M Such persistence proved instrumental in driving innovation and securing support within the military innovation ecosystem.

Experimentation Influencing the Innovation Ecosystem

The military innovation ecosystem encompasses a diverse network within the defense sector, bringing together research and development organizations, operational units, academia, industry partners, and government agencies. The collaboration of the actors fosters and facilitates innovation. In the innovative ecosystem military experimentation is indispensable for testing, securing advocacy, and consensus.^{H M} Through rigorous testing, evaluation, and adaptation in realistic settings, experimentation validates innovations' feasibility and underscores the potential to enhance operational effectiveness, efficiency, and readiness. The evidence from experimentation is critical in persuading stakeholders within the ecosystem; from policymakers, supporting agencies, defense contractors and senior military leadership; of the imperative to



invest in, adopt, and integrate new solutions^{-M} Ultimately, military experimentation bridges theoretical innovation and practical application, keeping the military innovation ecosystem dynamic, responsive, and equipped to tackle evolving defense challenges. ^M

Figure 3. Experimentation helps secure advocacy and consensus within the Innovative Ecosystem

(https://repositories.lib.utexas.edu/server/api/core/bitstreams/4dfca023-afe9-4a50- ch 8093-2a638ca02558/content)

Experimentation in the Future

In the next decade, the need to cultivate a culture of experimentation and iterative processes will grow due to the pace of technological progress. Hierarchical organizations employing established principles to foster innovation and experimentation will more effectively innovate, adapt, and develop new concepts. Implementing training programs focused on cognitive flexibility, problem-solving, and adaptability will improve the innovation environment as well as staff

creativity and idea generation. Using technology-driven initiatives, like simulations and scenariobased exercises, will enable service members to develop mental resilience and creativity. \underline{M}

Leadership must proactively foster an environment where ideas flow freely, and failures become learning opportunities, without fear of reprisal.^H Additionally, thoughtfully using technology, including simulators, crowdsourcing, and data analytics, will boost experimentation capabilities, allowing more tests, reducing costs, and broadening participation.^{MM} Educating personnel across the organization, from junior to senior personnel, on the basics of data analytics will empower them to leverage, understand, and develop experiments.^M A reward system recognizing successful innovations and the valuable lessons from failures will further motivate personnel by inspiring a mentality of learning and development.^M By embracing these strategies, hierarchical organizations will establish a dynamic culture where experimentation and innovation are crucial for operational success. Over the next 10-15 years, the focus on experimentation within military organizations will help drive the innovative ecosystem for technological progress, spur innovation, and enhance readiness.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Perplexity, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, the future changes in technology, changes to culture, and the understanding of the future environment, this report is sensitive to change due to new information.

Author: Krista J. Gueller

Hierarchy to Innovation: The Strategic Shift Towards Adhocracy Cultures

Executive Summary

Historically, it is highly likely (71-85%) that organizational cultures embodying adhocracy traits have demonstrated a significantly higher propensity for innovation, distinguished by their agility, creativity, and openness to risk-taking. This culture starkly contrasts traditional hierarchical cultures, which prioritize order, discipline, and stability, often at the expense of flexibility and rapid innovation. Despite the organizational inertia and resistance to change characteristic of many military structures, those that adopt adhocracy culture traits are highly likely (71-85%) to achieve increased levels of innovation over the next 10-15 years. This strategic shift will enable these organizations to effectively learn from their environments, leverage emerging technologies, and develop innovative operational strategies, thereby setting new standards for effectiveness and adaptability in the field.

Organizational Culture

As the pace of technological innovation increases, it will become crucial for organizations to adapt to the changing environment, innovate, and leverage technology to their advantage. An organizational culture plays a vital role in its ability to innovate and make the most of technology. There are many models and frameworks available for analyzing and understanding organizational culture. The Competing Values Framework (CVF) provides a good model to evaluate and understand organizational culture, leveraging two principal dimensions: Flexibility versus Control, and Internal versus External Focus (See Figure 1).^H The first dimension delineates a spectrum between an organization's inclination for flexibility, marked by adaptability and openness to change, and control, characterized by a desire for stability, orderliness, and uniform operations. The second dimension considers whether an organization's priorities are directed inward, fostering internal unity and member engagement, or outward, emphasizing competitive advantage, market presence, and interactions with the external environment^H By mapping these dimensions, the CVF delineates four organizational culture types-Clan, Adhocracy, Hierarchy, and Market-each supporting different strategies, leadership styles, and operational approaches, thereby serving as a strategic tool for leadership development and cultural enhancement.H

- 1. Clan Culture emphasizes an internal focus and values flexibility over stability and control. This culture is characterized by a family-like atmosphere where mentoring, nurturing, and participation are encouraged. Clan cultures prioritize loyalty, tradition, and teamwork, with leadership often seen as mentorship.
- 2. Adhocracy Culture is dynamic and entrepreneurial, with a strong emphasis on innovation and risk-taking. These organizations are externally focused, valuing flexibility and

readiness to adapt to new opportunities or challenges. Creativity and cutting-edge work are the hallmarks of Adhocracy Culture, with leadership that motivates through vision and innovation.

- Market Culture is results-oriented, focusing on competition, achievement, and getting the job done. These cultures prioritize external positioning and control, aiming for efficiency, productivity, and meeting targets. Leadership in a Market Culture is often competitive, demanding, and goal-focused.
- 4. A Hierarchy Culture structures the workplace formally, emphasizing internal focus and control. It establishes a clear chain of command, and members must follow procedures closely—this culture values efficiency, stability, and doing things correctly. The leadership style is based on organized coordination and monitoring, focusing on reliability and smooth operations.



Figure 1. Competing Values Framework (https://trupathsearch.com/competing-valuesframework/)

Military Organizational Culture

The military is traditionally associated with a Hierarchy Culture, emphasizing structured processes, policies, regulations, and a strong emphasis on the chain of command. ^HThis culture values stability, order, control, formalization, and routinization, which are critical for maintaining discipline and efficiency in military operations.^H The inherent characteristics of a Hierarchy culture, such as conformity and predictability, support the military's need for clear roles, rules, and regulations, ensuring efficient and smooth operations. ^H Hierarchy cultures are the least innovative of all four culture types.^H

Hierarchy Culture and Innovation

Organizations inclined towards a hierarchy culture with high stability and control must increasingly integrate aspects of an adhocracy culture, which values flexibility and external focus. To do this, they might adopt practices where employees are encouraged to develop new ideas within the company or establish innovation incubators that operate semi-autonomously to explore new opportunities. ^H These initiatives foster an internal culture of innovation while maintaining the structured control necessary for efficient operations. Organizations can thus maintain a dynamic balance on the CVF axes, becoming more adaptable without losing the strengths of a hierarchy culture, such as reliability and consistent performance.

Adhocracy Organizational Culture and Innovation

Adhocracy organizational culture is the most powerful catalyst for innovation. It nurtures an environment where creativity, flexibility, and entrepreneurial thinking are at the forefront. ^H This culture thrives on experimentation, encourages risk-taking, and explores new ideas without fearing failure. It enables autonomy and independence, allowing members to pursue innovative solutions and leverage technology to break new ground. ^H Cross-functional collaboration is often the norm in adhocracy cultures, fostering a divergent perspective's that can lead to groundbreaking innovations. ^HAn emphasis on continuous learning ensures that the organization and its members remain adaptable and forward-thinking, always ready to capture the next wave of innovation. By creating a dynamic and open environment, adhocracy cultures enable organizations to respond to changes and actively shape the future through continuous innovation and adaptation.

Examples of Adhocracy Culture and Innovation

Adhocracy culture is a crucial driver of innovation. Several pioneering organizations exemplify this. Google epitomizes adhocracy by fostering an environment where creativity and risk-taking are encouraged. ^H The company has institutionalized innovation through its 20% time policy, having employees dedicate a portion of their work time to passion projects, leading to significant new developments such as Gmail and AdSense. ^M Google's leadership developed this culture by motivating through vision and pioneering initiatives, showcasing adhocracy's essence. ^M

Tesla, Inc., under Elon Musk's leadership, is a good example of the power of adhocracy in driving disruptive innovation within the automotive and energy sectors. Tesla's commitment to rapid innovation, experimentation, and sustainability mirrors the flexibility and adaptability inherent in adhocracy cultures. ^H By continuously pushing the limits of electric vehicles, energy storage, and solar products, Tesla has demonstrated an impressive level of readiness to embrace new challenges and opportunities. ^H

SpaceX, another company of Elon Musk, serves as a testament to the adhocratic culture's capacity to challenge the status quo, take significant risks, and foster continuous innovation. Its mission to reduce space transportation costs and enable Mars colonization underscores an ambitious, risk-taking culture that has achieved groundbreaking feats, such as the development and successful launch of reusable rockets.^{MH}

Pixar Animation Studios demonstrates adhocracy through its emphasis on creativity, collaboration, and willingness to take risks. The studio has cultivated an environment that encourages employees to pitch ideas, experiment, and learn from failures, enabling it to remain at the forefront of animated filmmaking with a consistent output of original, critically acclaimed, and commercially successful films. Pixar averaged a return on investment (ROI) of roughly

334%. Notable titles included Finding Nemo (\$936 million), Up (\$735 million), and Inside Out (\$857 million). $^{\text{H}}$

Integrating Adhocracy Traits into Traditional Hierarchies

Integrating adhocracy traits into traditional hierarchies showcases a transformative approach to innovation, as evidenced by the Department of Defense's DARPA (Defense Advanced Research Projects Agency) operations. Despite its placement within a hierarchical structure, DARPA exemplifies adhocracy by operating with autonomy and flexibility[.] ^H Tasked with developing emerging technologies for military use, DARPA can innovate by embracing risk-taking and challenging conventional wisdom. ^{HM} Its role in the early development of the internet and GPS technology underscores the innovative capacity inherent within hierarchical organizations that adopt adhocratic traits. ^H

The National Aeronautics and Space Administration (NASA) is a good example of the integration of adhocracy within a government agency known for its hierarchical elements. NASA has effectively incorporated adhocracy traits through its innovative culture, particularly evident in projects like the Mars Rover missions and the Artemis program. ^M By fostering creativity, encouraging cross-functional teams, and employing a problem-solving approach to tackle unprecedented challenges, NASA has continued to secure significant technological advancements and push the boundaries of space exploration. ^H

These examples demonstrate that organizational innovation transcends the limitations of industry constraints or traditional cultural foundations. Organizations that actively embrace adhocracy's principles of flexibility, creativity, and risk-taking position themselves to navigate and thrive in the ever-evolving landscape of global challenges and technological advancements. This strategic inclination towards adhocracy enables even the most traditionally structured organizations to effectively leverage emerging technologies, devise innovative operational strategies, and establish new benchmarks for effectiveness and adaptability. Through such dynamic cultural shifts, organizations like the U.S. military can innovate and thrive.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Perplexity, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, the future changes in technology, and the understanding of organizational culture, this report is sensitive to change due to new information.

Author: Krista J. Gueller

Shifting Sands: The Role of Cultural Evolution in Military Personnel Management

Executive Summary

Historically, it is highly likely (71-85%) that personnel management has acted as a pivotal catalyst for innovation. In an era characterized by rapidly evolving warfare, intense competition for talent, and the accelerated pace of technological advancements, military organizations stand at a crucial juncture. Those who proactively revise their personnel management culture to enhance flexibility, introduce diverse career paths, provide opportunities, and allocate time for advanced degrees and partnerships with industry, despite the challenges of change with traditional hierarchical structures, are highly likely (71-85%) to experience increased innovation and adaptability over the next 10-15 years. By adapting personnel management strategies to meet these evolving demands, organizations will not only boost their agility but will also secure a crucial competitive advantage as the character of warfare evolves.

Specialization and Career Flexibility

The interwar period illuminates the critical role of personnel management in enabling military innovation and adaptability. During this time, military organizations proactively identified, developed, and retained individuals with essential technical skills, providing a rich source of talent pool resulting in innovation and advanced capabilities. \mathbb{H}

The British military's advancements in radar technology were crucial during World War II, relied heavily on strategies to have flexible career paths with promotion timelines, and offered incentives for retaining radar experts. The military rapidly promoted Robert Watson-Watt, a radar technology pioneer, to a senior scientific role, despite his lack of formal military experience. ^M This action highlighted the military's recognition of its strategic technical expertise and its commitment to empowering specialists.^M

Similarly, the U.S. and British militaries emphasized the importance of cryptography by promoting talented mathematicians and linguists into key roles, offering them accelerated career paths and specialized training. The commissioning of William Friedman as a military officer and the facilitation of Alan Turing's work on the Enigma code demonstrates a willingness to leverage exceptional technical skills, irrespective of conventional military qualifications. ^M

It is important to note the profound impact of cultural and structural factors on the effectiveness of personnel management strategies, as the historical examples of the Soviet purges and the Imperial Japanese Navy's (IJN) hierarchical culture vividly demonstrate. ^M The late 1930s purges within the Soviet Union obliterated the ranks of experienced and innovative officers, severely hampering the advancement and execution of personnel initiatives. ^M This scenario starkly shows how eliminating key change agents devastates military preparedness and stifles innovation. ^M
Similarly, the IJN's strict hierarchical culture, while fostering discipline and loyalty, simultaneously suppressed dissenting voices and inhibited the free flow of innovative ideas. ^M Such internal cultural barriers significantly curtailed personnel's capacity to adjust to new challenges and to efficaciously implement novel strategies. These instances underline the paramount importance for military organizations to nurture an environment that values and rewards innovation, flexibility, and open communication while navigating both external and internal challenges. Achieving this delicate equilibrium is crucial for developing and maintaining a force that is both technologically adept and strategically versatile, fully prepared to tackle the complexities of contemporary warfare.

These historical examples underscore the argument for a more flexible and personalized approach to career development in today's military. The interwar period saw the introduction of adaptable career paths to accommodate emerging technological specializations, suggesting a career jungle gym model over traditional job ladders. This approach ensures officers and enlisted personnel gain comprehensive experience and develop deep expertise in critical areas like electronic warfare, cyber, and space operations.

Flexible Career Path

The integration of flexible career paths with experience and specialization highlights the evident need for a workforce that is more experienced and specialized. ^M The technical complexity of combat systems and the trend toward decentralized decision-making necessitate a higher level of expertise and experience. ^M By adjusting career lengths and ensuring promotions highlight experience, the military can develop a cadre of deeply specialized professionals ready to influence and lead in the technologically advanced future. ^M

Transitioning to a more flexible jungle gym model from the traditional, hierarchical career ladder strategically addresses these changes.^M This model would facilitate lateral moves, cross-training, interdisciplinary assignments, and the acquisition of additional expertise, catering to the diverse skill sets future operating environments require. The jungle gym model enables the concurrent development of broad-based experience and specialized knowledge. Specifically, this approach should include mechanisms that allow service members to transition seamlessly between roles, fostering the acquisition of new skills and experiences.^M This adaptability not only contributes to their professional growth but also boosts the military's operational effectiveness.

Key and Developmental Positions

A cultural shift within the military is imperative, one that values diverse career paths and timelines, and recognizes the strategic importance of both command and technical expertise.^M Traditionally, military structures have placed command positions at the center of career progression, reflecting a hierarchical and operationally focused view of military effectiveness.^M However, the changing nature of conflict, the growing significance of technology, and the

diversifying range of threats demand a broader perspective on what defines a key developmental position and how careers can progress. ^M The increasing value of technical expertise and specialization now stands out more than ever, with roles in cyber warfare, intelligence, electronic warfare, pilots, logistics, and medical services becoming crucial to operational success and strategic flexibility.

To make these shifts, military organizations must balance recognition and advancement opportunities between command tracks and technical or specialist tracks, acknowledging the critical contributions of specialized skills to mission success. ^M Establishing clear progression paths for technical experts, paths that do not pivot exclusively to traditional command roles, will help retain talent and foster deep technical influence and leadership. ^M Additionally, flexible career timelines will enable additional opportunities for advanced degrees, partnerships with industry, broadening positions and opportunities to specialize. ^M

As the military becomes more reliant on technology and the operational environment becomes more complex it will be critical to have personnel that can adapt to the changing environment, leverage technology and think critically about the problem. ^M As the military adjusts timelines and provides increased career flexibility it will also be critical for the military to leverage the skill sets of the force. If a service member has a unique skill, degree or specialized schooling the military must take this into consideration during the assignment process.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Perplexity, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, and understanding of the future environment, this report is sensitive to change due to new information.

Author: Krista J. Gueller

Flexible Doctrine Likely to Grant Notable Military Advantage Within Next 10 Years

Executive Summary

Due to recent changes in the character of war, including the introduction of new capabilities, domains, and environments, the adoption of *flexible military doctrine* – that allows for adaptable planning and execution of combat operations – is likely (56-70%) to give military organizations a decisive combat advantage within the next 10 years. Despite many entities (including the military-industrial complex and former senior military decision-makers) being highly likely (71-85%) to challenge the adoption of a new, flexible doctrine, history (both military and non-military) has shown that conservative adherence to rigid fundamental principles (e.g., military doctrine) applied against an adaptive adversary or competitor usually gives the latter a notable advantage.

Flexible military doctrine gives organizations, leaders, and Soldiers options to meet varied and changing circumstances by fostering adaptability, creativity, initiative, and interoperability.^H

Discussion

Recent decades have produced multiple examples where integrating relatively inexpensive capabilities into military operations has successfully circumvented traditionally more "powerful" military capabilities. This is evident in the use of drones (among other examples) to reduce the advantages of armor and massed formations within the Ukraine-Russia conflict, where NATO's "Lessons Learned" acknowledges changes in



Figure 1. A Grenade-Tossing Ukrainian Drone Knocked Out One Russian Tank-And Then Terrorized A Second Tank That Came To the Rescue (https://www.forbes.com/sites/davidaxe/2023/11/12/bullseye-agrenade-tossing-ukrainian-drone-knocked-out-one-russian-tank-andthen-terrorized-a-second-tank-that-came-to-therescue/?sh=60b81f35225a)

Clausewitz's "character of war."^H Likewise, the employment of simple and inexpensive Improvised Explosive Devices (IEDs) recently blunted U.S. military superiority in the Middle East.^M This trend is highly likely (71-85%) to continue as new technologies are developed and explored for military application, such as generative Artificial Intelligence (AI) which has been described as "rocket fuel for elevated ambitions," especially under creative human input.^H Flexible doctrine will likely be a crucial aspect of exploiting this potential. The changing character of war in recent years includes the addition of the cyberspace and space domains within military doctrine, as well as the importance of the information environment.^H. These changes are also reflected in significant changes to U.S. and Chinese military force structure. Recognizing the critical value of defensive and offensive cyber operations (in addition to vigilant cyber-security), the United States created U.S. Cyber Command in 2010.^H However, adversaries have continued to exploit cyber weaknesses, such as North Korea's attack on Sony in 2014.^H China's creation of the Strategic Support Force within its People's Liberation Army in 2015 highlighted the importance of space in future warfare by consolidating space, cyber, and information forces into a strategic-level military organization.^H The United States followed suit by re-establishing U.S. Space Command as a geographic combatant command^H and creating the U.S. Space Force as a separate military service in 2019.^H More recently, U.S. leaders have been concerned over Russia's development of dangerous anti-satellite weapons.^H Information operations (also referred to as information warfare), while not new, are becoming increasingly important in modern military operations as information technology and platforms are proliferated and integrated into societies.^H

Successful military operations enabled by flexible doctrine are reflected in many historical examples. Napoleon Bonaparte stated that "no rule of war is so absolute as to allow no exceptions," thus illuminating the need to avoid rigid thinking and allow exceptions within doctrine.^H Soviet military doctrine based on the "deep operation theory" of the interwar period, while greatly stifled by Stalin's purge of experienced military leaders in the late 1930s, allowed for flexible command and employment of forces, which enabled Soviet military success in the 1939 Soviet-Japanese conflict in Mongolia and eventually proved victorious in World War II.^{HM} U.S. amphibious doctrine, iteratively developed and refined by the Marine Corps as Landing Force Operations before and during World War II, incorporated a flexible command and control element that allowed landing forces to rapidly coordinate offloading operations under fire.^M Today, the U.S. Joint Warfighting Concept drives the development of joint doctrine and "provides the alignment and flexibility needed for each Service to develop, integrate, and synchronize joint capabilities" built on the "tenets of expanded maneuver and pulsed operations."^H

Multiple entities are highly likely to oppose the adoption and implementation of new, flexible doctrine and concepts that espouse the changing character of war. The current military-industrial complex is ill-suited to enable the flexible doctrine required to meet such challenges, but rather has become optimized to generate expensive platforms with limited combined/joint integration that are designed to meet explicit requirements.^H Likewise, many former leaders are also highly likely to oppose significant changes to the status quo, such as four retired Marine Corps Generals' recently published opposition^M to the Marine Corps' changes in Force Design 2030^H to enable Expeditionary Advanced Basing Operations.^H

Despite these challenges, several historical examples, both military and non-military, show that conservative adherence to rigid fundamental principles (e.g., military doctrine) applied against an adaptive adversary/competitor usually gives the adversary a notable advantage. Germany's development of flexible doctrine in the 1920s and 1930s enabled rapid success early in World War II;^H however, while France had a chance to adapt its doctrine and tactics after witnessing Germany's success in Poland in 1939, French leaders instead opted to rely on their perceived superiority which ultimately doomed France in 1940.^H Similarly, Blockbuster Video's refusal to adopt fundamental changes in its business model led to its downfall. Its CEO, John Antioco, sensed a growing threat from Netflix and Redbox that he felt required Blockbuster to make significant changes, namely to its late fees policy (which generated significant revenue).^H Rather than follow his lead, he was eventually ousted from the company and his replacement, Jim Keyes, reversed Anitioco's changes leading to Blockbuster's bankruptcy within five years.^H

Analytical Confidence

The analytic confidence in this estimate is *moderate*. Sources are generally reliable, with many historically grounded topics that have been well-studied for many decades. There was ample time for research, which was conducted both individually and among a project team, including available U.S. Army War College faculty experts. However, given the lengthy time frame of the estimate and the broad nature of military doctrine, this report is sensitive to change due to rapid changes in technology and its adoption in military operations.

Author: Kelly M. Raisch

Integration Stagnation: U.S. Joint Force Likely to Lose Joint Operations Advantage Over PLA Within 10-15 Years

Executive Summary

Compared to the Chinese People's Liberation Army (PLA), the U.S. Joint Force is likely (56-70%) to lose its current advantage of conducting joint operations due to U.S. joint service, structure, doctrine, and education factors, while the PLA appears on track to complete its modernization efforts, including improved joint operations integration, by 2035. Despite the newness and limited success of recent PLA joint integration efforts, as well as the U.S. military's recent integrated deterrence strategy and Joint Warfighting Concept (JWC), the PLA maintains an aggressive drive that is likely to meet modernization timelines. Meanwhile, the potential for U.S. retrenchment in foreign policy and U.S. military service parochialism amid resource competition make integrated deterrence and the JWC unlikely (31-45%) to succeed.

Discussion

Integrated and unified processes among military organizations, as well as with external entities, are historically linked to achieving military success. Integration across services and domains, often supported through universally accepted or joint doctrine, also includes interoperability between systems, forces, and planning.^M Likewise, "a society's economic structure, political organization, technological capabilities, and values are among the qualities that both enable and constrain its war-making powers."^H

German military rearmament and doctrine development leading up to World War II provide a great example of such integration at all levels. Seeking to avoid the static, attrition-based warfare that characterized the First World War, innovative officers developed a doctrine that maintained an offensive initiative by closely integrating mechanized, armored, and motorized ground forces with air power.^{\underline{H}} To unify external processes, "the German military underwent a dramatic strategic modernization process that is best described in terms of an institutional triangle. That is, the planned evolution rested on public impact, on the attitudes of workers, and the technocratic rule."^{\underline{H}} Throughout this interwar period, Germany



Figure 1. Conceptual representation of German "Blitzkrieg". Click on the picture or go to: https://bigserge.substack.com/p/german-rebirth-blitzkrieg. Source: Bigserge.substack.com

underwent a "strategic revolution...in which the unified approach to German strategy devolved into two directions, the management of arms on the one hand and ideological "strategy" on the other... When the capabilities of the two were fused in a single effort between 1938 and 1941, they propelled Germany into World War II."^{\square}

Well-developed, integrated, and unified processes enabled the Japanese empire's success in the 1930s and early 1940s. Japanese Army and Navy leaders applied lessons learned from years of fighting in China to improve planning and organizing joint expeditionary forces.^H Consequently, the Malaya campaign in late 1941 was characterized by "superb cooperation between the land and naval forces and the air arms of both services."^H Japan developed "joint task forces," that were "organized during the summer of 1941 [that] trained and worked together continuously...[ensuring] details of command, supply, and other matters were carefully worked out in advance and clearly understood by all concerned."^H



Figure 2. Conceptual diagram of the evolution of the PLA's Joint Operations concept. Click on the picture or go to: https://www.nids.mod.go.jp/publication/chinareport/pdf/china_report_EN_web_2022_A01.pdf. Source: Nids.mod.go.jp

More recently, Chinese People's Liberation Army (PLA) reforms "began in earnest in 1978 during the "reform and opening" period ushered in by then-Chinese leader Deng Xiaoping."^H However, PLA modernization efforts increased significantly in the 1990s, particularly in response to the U.S. military's stunning success in expelling Iraqi forces from Kuwait. ^{HM} Chinese leaders "engaged in a sustained and broad effort to transform the PLA from an infantry-heavy, low-technology, ground forces-centric military into a high-technology, networked force with an increasing emphasis on joint operations and naval and air power projection."^H These efforts received a boost in 2015 to "expand the scope and nature of active defense" and in Xi Jinping's 2017 call "for the [PLA] to complete its force modernization effort by 2035 and field a

world-class military capable of fighting and winning wars in any theater of operations by 2050.^{MH}

Focusing its modernization efforts, the PLA developed its "systems destruction warfare" concept to operationalize "informationized" warfare which in turn required a significant level of joint integration.^H Recent "ambitious" reorganizations therefore sought to "optimize joint operations," such as "distributing resources more equitably among the services" and "replac[ing] the PLA's seven military regions, which had been optimized for peacetime administrative functions and dominated by the ground forces, with five theater commands with delineated geographic responsibilities and a structure more conducive to joint operations."^H Further enabling integrated and unified processes, the PRC issued a new joint doctrine (called *Guidelines*) in 2020 and adopted its "Civil-Military Fusion" strategy to eliminate "barriers between China's civilian research and commercial sectors, and its military and defense industrial sectors."^{HH}

While U.S. military history contains many examples of successful joint operations, deteriorating joint interoperability after the Vietnam conflict – as evidenced in U.S. operations in Iran in 1980 and Grenada in 1983 – brought about significant Congressionally-driven reforms.^H The Goldwater-Nichols Act of 1986 stripped Service Chiefs of operational responsibilities (assigning duties instead to unified Combatant Commanders to employ joint forces globally) and created specific laws governing the employment of joint forces as well as the development of joint officers.^H During this time, the Senate Armed Services Committee "identified poorly developed joint doctrine as one of the symptoms of inadequate unified military advice," and consequently assigned development and maintenance of joint doctrine to the Chairman of the Joint Chiefs of Staff.^M Less than five years after passing this legislation, the U.S. military successfully led a coalition force in expelling Iraqi forces from Kuwait.^M

As the PLA aggressively continues to improve joint integration in marching toward its 2035 modernization goal, the U.S. military's effort to maintain an advantage in joint operations has stagnated. Not only is joint education not required prior to serving in a joint command, but joint education requirements increasingly take a back seat to other educational requirements and objectives at military educational institutions.^M Consequently, Joint Professional Military Education (JPME) phase II has simply become a "check in the box" for career progression and promotion.^M The value (and requirement) of joint duty assignments has also been diluted in recent years.^M The disestablishment of Joint Forces Command in 2011 "left the preponderance of U.S. conventional military forces under the exclusive control of their respective services," thus reducing the requirement for forces to operate under a joint command and was subsequently reinforced by legislation in 2017 to preserve service-retained forces.^M Joint doctrine tends to reflect a "watered down" amalgamation of portions of service-specific doctrine, developed within a "consensus-based system" that drives toward the "lowest common denominator of agreement."^{MH} The current "ideology of jointness" within the U.S. military tends to promote

"equal share" across the services for operations, defense policies, joint doctrine, and the defense budget.^M

The PLA's reforms toward improving joint integration, including reforms in organizational structure, joint concepts and doctrine, geographic responsibilities, and education, have mostly been implemented in the last decade. Therefore, while successful indications appear limited, assessing the overall effectiveness in reforms to improve integration and unified processes is likely to prove difficult within the next five years. However, the scope and scale of reforms within the PLA in recent years have been profound and "may render by 2035 (if not before) a PLA that is capable of greatly increasing the risks and costs of U.S. and allied contingency responses throughout the Indo-Pacific region."^{MH}

The U.S. military has recently instituted a strategy of integrated deterrence, enabled by an iteratively developed Joint Warfighting Concept (and recent associated doctrine), to improve integration within and external to the Department of Defense (including Allies and partners) and align service concepts and doctrine.^{HM} However, the potential for U.S. foreign policy retrenchment in the near future is likely to weaken the efficacy of integrated deterrence.^{MM} Likewise, inter-service tensions at the highest levels related to operational relevance and competition of resources (i.e. defense budget) is likely to stifle initiative among the services to improve joint integration.^M

Analytical Confidence

The analytic confidence in this estimate is *moderate*. Sources are generally reliable, with historically grounded topics that have been well-studied for many decades. There was ample time for research, which was conducted individually using available, open-source resources. However, given the lengthy time frame of the estimate, limited sources in assessing PLA joint operations, and the potential for unforeseen world events, this report is sensitive to change.

Author: Kelly M. Raisch

Key Characteristics, Empowerment and Autonomy of Subordinate Military Leaders Highly Likely to Provide Crucial U.S. Advantage in Next Conflict, Next 10-15 Years

Executive Summary

Empowerment and autonomy of subordinate military leaders are highly likely (71-85%) to provide the United States a crucial advantage in a conflict within the next 10-15 years due to the historical significance of these factors and their incorporation within U.S. military doctrine. Despite shortcomings in military leadership early in the Cold War and recent tendencies for information systems to stifle empowerment and autonomy, the development of leaders within the information age, combined with an American culture of individualism and autonomy, is likely (56-70%) to foster an innovative culture rooted in empowerment and autonomy.

Discussion

Organizational autonomy is a primary factor in producing innovation and organizational adaptation.^H In contrast, micromanagement creates fear, tension, and hesitancy within subordinates, thereby stifling creativity.^H Empowering subordinates is crucial; it "shares power and transfers responsibility and autonomy to the subordinate," which promotes "intrinsic motivation."^H Combined with a clear

organizational mission or purpose and an open culture that fosters



Figure 1. The Benefits of Subordinate Empowerment. Click on the picture or go to: https://fastercapital.com/topics/startups-that-successfully-use-employee-empowerment-strategies.html. Source: Fastercapital.com

debate, these factors enable creativity, adaptation, and adoption of new ideas and technologies, despite a lack of resources or other constraints.^{\underline{H}}

These factors proved increasingly important in the 19th century as new weapons and technologies (e.g. rifled small arms and explosive artillery shells) forced greater dispersion of combat formations.^H For instance, Japanese success in the battle of Malaya and Singapore in 1941-42 is largely attributed to superior Japanese empowerment and autonomy of tactical units compared to their British counterparts in the campaign.^H While Japanese officers were authoritarian and "harshly punitive, they empowered their subordinates and respected their judgment."^H Entrusting "autonomous missions to junior officers and NCOs," Japanese forces invaded Malaya to

"infiltrate the jungles and attack the British rear, block lines of retreat, destroy supplies, and kill specific officers." \underline{H}

British leadership, on the other hand, was highly centralized, paternalistic, and "intolerant of unfamiliar ideas and people."^H They dismissed or downplayed subordinate concerns regarding a Japanese attack and squashed initiatives to fortify Singapore.^H While British forces were "more-numerous, better-armed, and better-supplied," Japanese forces advanced through 500 miles of jungle in 54 days and sacked Singapore after only a week of British resistance.^H

The battle of France in 1940 provides another example from this period. In the years before this pivotal battle of World War II, the German officer corps developed a culture that encouraged innovation.^H Its general staff officers were "unashamedly elitist...highly trained, [and] intellectually capable...[yet] devolved authority and initiative downward to lower-ranking officers."^H They "emphasized trust across ranks, decentralization of authority, and develop[ed] in junior leaders the competence and judgment that would make empowering them militarily feasible."^H This culture fostered the development of a doctrine consisting of rapidly advancing armored and motorized formations with highly integrated close air support - the "blitzkrieg." However, during this same period, the British and French "neither seriously debated the lessons of the First World War nor achieved any substantial innovation in their forces."^H French officers valued centralization of authority based on their First World War experiences.^H While Charles de Gaulle (a French army officer) came up with new ideas for future warfare, "these visions came to naught as a series of organizational and cultural impediments blocked serious innovation."^H Throughout the battle in the spring of 1940, the starkly contrasting forms of command, control, and overall decision-making greatly facilitated German superiority and success.^H German forces, "numerically inferior in trained men, armor, aircraft, and artillery," defeated a well-fortified French army within six weeks.^{HH}

A culture of employee empowerment in the business world is also known to exhibit several benefits, including enhanced engagement and satisfaction, greater innovation and creativity, improved decision-making and problem-solving, and higher retention rates.^M Effective empowerment comprises setting a clear vision (including expectations and guidelines), delegating appropriate authorities, providing resources and support, providing psychological safety, encouraging open communication and feedback, and fostering a culture of learning and growth.^{MM} Google's training and development programs, which reflect many of the above attributes, foster innovation by empowering employees.^M For instance, their G2G program allows employees to "self-nominate" for training courses on a variety of topics, which are taught voluntarily by other employees.^M Likewise, Google's "whisper courses" – a micro-learning approach using a series of emails – provide greater psychological safety within the company's teams.^M

While naval commanders have traditionally been empowered to operate autonomously under general instructions, empowerment and autonomy have become increasingly fundamental across all U.S. military doctrine.^{MH} The U.S. Army coined the term mission command in 2003, which is currently defined in Army doctrine as: "the Army's approach to command and control that empowers subordinate decision making and decentralized execution appropriate to the situation."^{MH} The U.S. Air Force has also formally adopted mission command within its doctrine to enable its recent Agile Combat Employment (ACE) concept of distributed operations.^M The newest U.S. military branch, the U.S. Space Force, codified mission command within its recently published doctrinal publication Space Doctrinal Publication 3-0.^H Marine Corps doctrine has included tenets of decentralized control and decision-making, maintaining initiative, and mission tactics within a maneuver warfare construct since the 1980s.^H



Figure 2. The Evolution of U.S. Military Policy 1775-2019. Click on the picture or go to: https://www.rand.org/content/dam/rand/pubs/tools/TL200/TL238/RR1995z1_7-30-2019.pdf. Source: Rand.org

The U.S. military has faced challenges to empowerment and autonomy since World War II. For instance, the U.S. Army at the outset of the Korean conflict included officers who "adopted authoritarian behavior patterns such as uncritical submission to superiors, hostility to innovation, and indifference toward subordinates. They did not trust their troops or teach small units how to act on their own." ^H After defeating the North Korean People's Army, they were subsequently routed by the Chinese Army.^H Following the conflict, force structure policy maintained a larger regular Army over reserve forces (improving stable career paths for experienced leaders) until the eventual shift to an all-volunteer force traded quality over quantity among enlisted ranks.^{HH}

Another challenge is the tendency in recent decades for technological information systems that support command and control to "bypass chains of command…and create an insatiable need for certainty and immediacy."^M However, as military leaders developed within an "industrial age model" turn over with a new generation of "information age" leaders, this tendency is likely to abate as the underlying American culture of individualism and autonomy continues to permeate the military.^{MM} This will prove crucial as future military leaders at various levels are forced to innovate, through reliance on empowerment and autonomy, under disrupted, degraded, or compromised information systems.

Analytical Confidence

The analytic confidence in this estimate is *moderate*. Sources are generally reliable, with many historically grounded topics that have been well-studied for many decades. There was ample time for research, which was conducted both individually and among a project team. However, given the lengthy time frame of the estimate and the potential for drastic technological and cultural changes, this report is sensitive to change.

Author: Kelly M. Raisch

AI Frontiers: Navigating Ethics and Advancement in Military Dominance

Executive Summary

Adopting Artificial Intelligence (AI) in military systems marks a transformative shift in warfare, reminiscent of the ethical and strategic complexities seen during the interwar period when nations diverged from international ethical norms. Ethical governance is highly likely (71-85%) to impede AI development for military applications due to stringent adherence to ethical standards and international laws, which may moderate the pace of innovation and deployment, particularly in the United States. Despite these constraints, including the potential slowing of technological progress and the need to navigate complex legal and moral landscapes, the United States, China, and Russia are pursuing divergent paths in developing and deploying military AI.

Discussion

While the United States maintains a solid commitment to ethical governance, emphasizing responsibility and compliance with international norms, China and Russia opt for a more pragmatic approach, prioritizing state security and military modernization, which might sidestep specific ethical and human rights concerns. This strategic variation underlines the intricate balance between ethical governance, technological advancement, and strategic military utility. The analysis highlights the differing impacts of these approaches on the global stage: the United States adherence to ethical standards could limit its pace in AI military innovation, China leverages its lenient ethical stance to accelerate development and gain strategic advantage, and Russia, though not as quick to innovate, strategically deploys AI to maintain its military competitiveness. Within this paradigm of advancing AI, it becomes imperative for the United States to keep pace with competitors, at least minimally for countermeasure purposes, to avoid being outpaced and overmatched.

The advent of AI in military systems represents a new chapter in warfare, echoing the ethical dilemmas and strategic challenges of the interwar period. During that era, ethical lines were blurred as Germany bypassed the Treaty of Versailles, notably through the 1922 Rapallo Treaty with the Soviet Union. This agreement enabled Germany to covertly develop and test weapons, including the Panzer I tank at the Kama tank school near Kazan, and conduct military training on Soviet territory, skirting Allied prohibitions. Meanwhile, Japan engaged in egregious acts of violence in China, such as the December 1937 Nanjing Massacre (200K casualties, 20K rapes), and the United States turned inward, adopting an isolationist stance in the face of Axis expansionism. In today's discussions surrounding military AI, similar ethical divergences are emerging, with the United States maintaining its commitment to ethical principles, responsibility, and international norms, a stance that mirrors its historical pivot to confront global threats. However, China and Russia opt for a more pragmatic approach, focusing on state security and military modernization at the potential cost of ethical and human rights standards. This strategic

variance highlights the tension between adhering to ethical principles and achieving military superiority.

The United States champions human-machine teaming and meaningful human control over decision-making processes within autonomous weapons systems (AWS), such as the U.S. Navy's Sea Hunter, emphasizing the augmentation rather than replacement of human decision-making with AI. ^M China's military AI initiatives, such as the Blowfish A3 armed drone, exhibit rapid development and deployment capabilities, advantaged by lower ethical barriers, thus posing questions about human oversight and the potential for unintended escalation. ^H Similarly, China is using AI in the field of Information and Electronic Warfare; AI is being employed to disrupt, deceive, and degrade electronic communications and data of adversaries. It's worth noting that Chinese laws have no privacy restrictions for state security organizations, which enables mass surveillance of the population using AI technologies. ^H Russia's ambiguous stance on ethical considerations in AI development suggests a willingness to leverage AI for strategic military purposes, potentially at odds with international norms. These contrasting approaches underscore a complex trade-off between ethical adherence and strategic agility in militarizing AI technologies.

The ramifications of these divergent ethical frameworks on global security, human rights, and international cooperation are profound. An AI arms race, fueled by the strategic pursuit of AI superiority without adequate ethical safeguards, could destabilize international security architectures, erode global norms, and precipitate a security dilemma characterized by rapid, unchecked AI deployment. ^H The deployment of AI in surveillance and social control measures, particularly by regimes with lower ethical constraints, portends a future of enhanced state power over individual freedoms, necessitating a concerted international effort to establish shared norms and governance frameworks for AI. ^M As AI technologies continue to evolve, the need for a global dialogue on ethical AI usage in military contexts becomes increasingly critical, with potential pathways including the development of international treaties that aim to harmonize AI development and deployment standards across nations, ensuring AI serves to enhance global stability rather than undermine it. ^M

A Multi-Criteria Decision Making (MCDM) analysis scrutinized the AI military capabilities of the United States, China, and Russia, separating the strategic intricacies across four critical dimensions. These dimensions include:

- Ethical Governance: Focuses on each country's commitment to ethical standards, essential for upholding global security and human rights.
- **Innovation Speed:** Measures how swiftly AI technologies are developed, indicative of a nation's ability to forge ahead in military AI.
- **Deployment Readiness:** Assesses the preparedness of AI systems for practical military use, a key factor in operational efficacy.

• **Strategic Advantage:** Evaluates the cumulative benefits of AI military technologies, factoring in technological supremacy and operational effectiveness.



Military AI Capabilities and Ethical Governance Comparison

Figure 1. This radar chart denotes a visual comparison of the United States, China and Russia's AI capabilities encapsulating Ethical Governance, Innovation Speed, Deployment Readiness and Strategic Advantage. This inclusive approach denotes a country's navigation through the complexities of AI in military realms, contrasting ethical governance with the imperative for swift technological progress and strategic deployment. It highlights the divergent paths taken by the United States, China, and Russia in the global AI arms race. The United States, adhering strictly to ethical standards, faces a dichotomy between maintaining ethical integrity and achieving rapid AI innovation and deployment, potentially curbing its competitive edge. In contrast, China leverages more lenient ethical constraints to expedite AI development and deployment, securing a significant strategic advantage. Meanwhile, Russia, though lagging in innovation speed and

deployment readiness, employs strategic acumen in AI military utilization, maintaining competitiveness. This intricate analysis underscores the pivotal role of ethical governance in military AI development and its profound impact on global military dynamics, advocating for a balanced approach that integrates ethical considerations, technological innovation, and strategic foresight to enhance military capabilities and foster stable international relations.

Analytic Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Michael McCray

Strategic Leadership and Innovation Culture: Catalyzing Military Breakthroughs

Executive Summary

A Multi-Criteria Decision-Making (MCDM) analysis has identified risk tolerance, resource allocation, and recognition as three of the 10 innovation drivers where improvement is likely (56-70%) to bolster an organization's innovation culture. Despite the hurdles of integrating these strategies into various military contexts and overcoming the inertia of existing norms, such efforts are pivotal for cultivating innovation. This analysis draws upon historical precedents such as the U.S. military's Manhattan Project, showcasing the significant impact of targeted resource allocation on research and development. Similarly, the pioneering adoption of stealth technology underscores the critical role of risk tolerance in fostering technological breakthroughs. Furthermore, establishing a comprehensive recognition system, highlighted by the U.S. Navy's Innovation Awards, is crucial for valuing innovative efforts across all organizational levels. Prioritizing these areas based on the MCDM analysis is vital for transcending conventional operational challenges and effectively navigating future obstacles.

Discussion

Historical examples illustrate the critical need to foster an innovation culture within military organizations. This innovation culture is underpinned by 10 key drivers that have proven essential in the development and execution of groundbreaking military strategies and operations. As demonstrated by General David Petraeus with his implementation of a counterinsurgency strategy in Iraq, visionary leadership highlights the impact of setting a strategic direction that diverges from traditional tactics to address complex environments through innovative thinking. ^HThe concept of empowerment, illustrated by the German military's "Auftragstaktik," shows the importance of allowing soldiers at all levels to exercise critical thinking and decision-making, fostering a culture of trust and innovation. ^H

Further drivers include the emphasis on collaboration, with DARPA's efforts to unite academia, industry, and government in pursuing technological breakthroughs for national security, showcasing the value of diverse perspectives in spurring innovation. ^M The significance of resource allocation is exemplified by the U.S.

10 Drivers of Innovation Culture: 1. Visionary Leadership: Set strategic directions to foresee and address future challenges, moving away from traditional methods. <u>MMM</u>

2. Empowerment: Delegate authority to enable independent decision-making and problem-solving. ^{MM}

3. Collaboration: Bring together diverse expertise to foster innovative outcomes and technologies. <u>MMM</u>

4. Resource Allocation: Invest in significant projects to pioneer new technologies or solutions. <u>MMM</u>

5. Learning Orientation: Analyze past actions to continuously refine processes and strategies. MMM

6. Tolerance for Risk: Undertake uncertain projects with the potential for significant rewards. MMM

7. Open Communication: Encourage free exchange of ideas, allowing innovations to emerge from all organizational levels. MMM
8. Diversity: Include a wide range of experiences and perspectives to enrich problem-solving and innovation. M

9. Recognition and Incentives: Acknowledge and reward contributions to innovation to stimulate creativity. ^{MM}

10. Agile Practices: Implement flexible strategies for rapid adjustment to changes, enhancing efficiency. ^{MM}

military's investment in the Manhattan Project, which underscores the transformative potential of dedicating resources to research and development. A learning orientation is vital, as seen in the U.S. Army's After Action Reviews, which promote continuous improvement and innovation. Risk tolerance is another crucial factor, with the development of stealth technology illustrating the necessity of embracing potential failure in pursuit of game-changing capabilities. ^M Open communication, as practiced by the Israeli Defense Forces, encourages the free exchange of ideas and challenges assumptions, leading to innovative strategies and technologies. ^{MM}

Moreover, integrating diverse teams enhances problem-solving capabilities and brings new insights, as seen with the U.S. military's inclusion of women in combat roles. Recognition and incentives are pivotal in motivating further innovation, exemplified by the U.S. Navy's Innovation Awards Program, which celebrates significant contributions to creativity and continuous improvement. ^M Lastly, adopting agile practices, such as the U.S. Air Force's use of Agile Development methodologies, facilitates rapid adaptation to the dynamic conditions of modern warfare. ^M Collectively, these drivers form the foundation of a culture that fosters innovation within military organizations and ensures their readiness and effectiveness in facing future challenges.

To effectively advance innovation culture within military operations, strategic leadership must focus on enhancing three critical drivers of innovation: risk tolerance, resource allocation, and recognition. By increasing risk tolerance, leaders can pave the way for pioneering military strategies and technologies similar to the development and deployment of stealth technology. This requires a bold acceptance of uncertainty for significant advancements. Optimizing resource allocation is critical; drawing lessons from the Manhattan Project's success and allocating resources wisely can lead to monumental breakthroughs by focusing on research and development that address current and future threats. Furthermore, the establishment of a more inclusive recognition system is crucial. Inspired by the U.S. Navy's Innovation Awards Program, such a system would celebrate achievements across all ranks and departments and motivate the entire organization towards continuous innovation and improvement. These strategic enhancements in embracing risks, judiciously allocating resources, and broadening the scope of recognition are indispensable for fostering an innovation culture that prepares military organizations for future challenges. **Figure 1.** This radar chart presents an AI-generated multicriteria decision-making (MCDM) analysis that assesses strategic leadership and innovation culture against 10 key drivers of innovation. It highlights existing gaps, particularly in risk tolerance, resource allocation, and recognition within the innovation domain. The chart suggests that addressing these gaps is essential for refining strategic leadership and enhancing the overall innovation culture.

Analytic Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a



-Strategic Leadership — Innovation Culture

multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Michael McCray

Patterns in Interwar Period (1918-1939) Government and Business Research Activities: Creating Depth and Breadth of Knowledge to Harness Intellectual Thought

Executive Summary

It is Highly Likely (71-85%) that maintaining a high degree of collaboration and robust funding between the central government and business/private research communities will result in a healthy economic environment and create an enduring military advantage over countries with less developed collaboration systems. This is based on evidence from examining the experiences of the interwar period in the United States, France, and Germany. This is also true despite the talent loss Germany experienced due to the Nazi political regime, which was counter-balanced by years of directed research and collaboration.

Discussion

The Interwar Period was a time of significant transformation and upheaval in various spheres of life, including politics, society, economy, and technology. The aftermath of World War I saw a global shift towards rebuilding and modernization, where governments increasingly recognized the importance of research and development (R&D) for national security and economic competitiveness. What makes this period interesting is the study of the different approaches nation-states adopted to address their unique security challenges and economic development desires to determine what will likely be the right approach for the beginning of the 21st century.

U.S. government funding and collaboration with private industry for research was limited at the beginning of the Interwar Period (1918-1939). Most technological advancements came from

private sector research labs or philanthropies like the Rockefeller Foundation. Companies like Bell Labs and General Electric focused on applications that incidentally had military potential. Bell Labs pioneered long-distance transmission of television images in 1927 and radio astronomy in 1932. ^M General Electric famously produced the vacuum tube, which paved the way for microwaves (radar), and the magneto compass in 1929, a lighter, more accurate earth-indicator compass used by many planes and guided Charles Lindbergh to a U.S. coast-to-coast speed record. ^M The U.S.



Figure 1. Source from GE Aerospace website (https://www.geaerospace.com/news/articles/100year-anniversary/ges-compass-guided-lindberghsall-over-world)

federal government's lack of involvement in creating a balanced commercial and defense innovation strategy became a significant problem for the U.S. military's readiness compared to more technologically sophisticated land forces like France and Germany at the dawn of World War II. U.S. scientists, politicians, and military leaders soon realized that the Interwar Period's research

and development (R&D) efforts were inadequate to support an Allied victory, and a centralized effort was needed to mobilize, coordinate, and direct technological and scientific research. ^M With the increasing possibility that the United States would be pulled into the war raging in Europe, President Franklin Roosevelt, in June 1940, established the National Research Defense Committee (NRDC) and the Office of Scientific Research and Development or OSRD



Figure 2. Planning Board and the Section on Uranium (OSRD) (https://www.osti.gov/opennet/manhattan-project-history/People/CivilianOrgs/osrd.html)

as an urgent response to the fall of France that same year. "Over the next four years, OSRD managed a wide-ranging research portfolio that produced major advances in fields as diverse as radar, nuclear fission, optics, rocketry, jet propulsion, electronic control, vaccines, antibiotics, antimalarials, and human physiology."^M The NDRC and later the OSRD (e.g., Manhattan Project) employed an innovative approach to directing research. These federal agencies focused on executing contracts with private industry labs and universities, providing funding and performance management, and building trust between federal and private industry.

Germany, heavily restricted by the Treaty of Versailles, took a more centralized approach to state-sponsored private research funding during the Interwar Period. However, even before the Interwar Period, in 1887 Germany was one of the first nations in Europe to create a public research laboratory system. In the following years, business entrepreneurs and the central government leveraged this industrial research system to create a healthy innovation ecosystem. Notable inventions by German scientists include Wilhelm Rontgen (1845-1923), who discovered the X-ray; Karl Bentz (1873-1929), who invented the 4-stroke automobile engine; and Christian Hulsmeyer (1881-1957), who developed the first machine to use radio-waves to detect objects at a distance; radar (telemobiloscope).^M The partnership between Germany and privately funded research led Germany to become one of the most complex economies in Europe by 1913; it expanded its reach into many international markets by exporting machinery and other technologies.^M

With the rise of the Nazi political party to power, the German economy shifted, and so did the priorities of the state. The Nazi regime undertook a comprehensive approach to R&D, focusing on creating synergies between the government, the military, and industry. This strategy began in 1933 and was known as the "Wehrwirtschaft" or defense-based economy. It was envisioned as

much by German military leaders as politicians to generate the necessary resources to conduct total war. ^M The Nazi regime also established the "Reichsforschungsrat" (Imperial/Reich Research Council) in 1937 to coordinate scientific research in support of national goals and secret rearmament efforts. Significant emphasis was placed on technologies with military applications, including rocketry, jet propulsion, and nuclear research. Companies like IG Farben and Siemens were deeply involved in advancing innovation in these efforts, benefiting from government contracts. These efforts saw the development of the V-2 rocket and the beginning of jet aircraft. ^M Finally, it is worth noting that with the rise of the Nazi political party and the move of Germany toward a more authoritarian state, the societal environment became hostile to the Jewish community. This hostility resulted in notable scientists fleeing the country for America, such as Nobel Prize winners Albert Einstein (1921) and Enrico Fermi (1938).

In the mid-1930s, fearing German military resurgence, France prioritized state-directed research to fund its rearmament efforts. ^M However, cultural beliefs within its scientific community

prevented this partnership from reaching its full potential. From 1918 to 1939, in perhaps a subconscious attempt to reject the horrors of the First World War, France's scientific culture professed a belief that science and engineering were overwhelmingly a matter of teaching and the application of contract research and not the quest for wholly new knowledge. ^M Without the support of the national government, France's research labs and scientific community were fragmented compared to the ongoing German centralized collaboration. Further, France's industrial economy gave little monetary reward to individuals to develop new industrial



Figure 3. Spad VII sporting an Eclair propeller (Source: Dassault Aviation https://www.dassaultaviation.com/en/passion/aircraft/military-blochaircraft/eclair-propeller/)

processes, a stark difference from economic incentives in the United States. Bureaucratic hurdles and a lack of coordinated national strategy often hampered efforts to foster government and private sector collaboration, which stifled invention. ^M However, France made notable advances in areas such as aviation and armor vehicles, with government-supported companies like Dassault Aviation (then known as Société des Avions Marcel Bloch). ^M The establishment of the French National Centre for Scientific Research (NCSR) in 1939 marked a step towards a more structured approach to government-sponsored scientific research, increasing collaboration among the different disciplines and a more directed approach to support national security. ^M This move, however, was far too late to prevent the defeat of France in June 1940.

The Interwar Period was a critical juncture in the evolution of government-business relations, especially in research and development. The era witnessed a significant expansion of state involvement in economic activities and deepened the symbiosis between the public and private

sectors in pursuing technological advancement. These developments laid the groundwork for the post-World War II economic order and the subsequent rise of the modern research-intensive state. ^M At different rates, the United States, Germany, and France all recognized the importance of leveraging the strengths of both the government and private sector in advancing technological capabilities, especially those with military applications.

Germany found the most advantageous relationship between government and private research funding due to revisionist political motivations and the desire to avenge the ills brought by the Treaty of Versailles. M

While having one of the strongest economies in Europe during the Interwar Period, France failed to harness the intellectual power of its science and engineering communities to benefit national defense. Its defeat was cemented in the lack of flexible warfighting doctrine within its National Defense community, which could not translate intellectual potential into meaningful warfighting capabilities compared to the German military machine. ^M

The United States benefited greatly from an environment that fostered collaboration and economic incentives to innovate. This environment created a wide breadth and depth of knowledge in many scientific and engineering disciplines, creating a sizeable intellectual potential that can be translated into national security capabilities if required. M

One significant commonality that both Interwar France and the United States highlight for the modern age is that nations rarely predict the timing of the next war. Failing to systematically support national scientific and research communities to develop warfighting capabilities commits the country to begin the next war ill-prepared, costing it valuable resources and human life. A constant from the 20th century remains that as nations compete, they must invest in their research to enhance national security and build technological superiority.

Entering the 21st century, more coordinated and strategic multinational partnerships could address the increasing cost of research and development activities born by national governments and allow access to a diverse community of intellectual thought. Additionally, this approach reflects an understanding that modern technological challenges are complex and interconnected, and the United States has developed a sophisticated alliance network that was absent during the interwar period.

Analytical Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from many respective academic and research authors, and tended to corroborate one another. However, sources with detailed knowledge of PRC & PLA budgets are minimal. Sufficient time was

available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-totext program was used to assist with research questions.

Author: Douglas Simmons

The Crucial Role of Quadruple Helix Collaboration in Adapting to the Accelerated Pace of Technological Advancements

Executive Summary

Historically, it is highly likely (71-85%) that military organizations with increased collaboration across the quadruple helix system which includes academia, private sector, government, and social society, have increased innovation and adaptability. Despite the hierarchical organizational culture of the military, which inherently emphasizes stability and order, it is highly likely (71-85%) that, over the next 10 to 15 years with the increased speed of technology development organizations with increased cross-sector collaborations of the quadruple helix system will have increased levels of innovation and adaptability.

Quadruple Helix Model and Cross-Sector Collaboration

The innovation ecosystem is the overarching system that enables innovation (see Culture of Experimentation Report). Within the innovation ecosystem, the quadruple helix model (Figure 1) illustrates the importance of collaborative interactions among four main actors; academia, the private sector, government, and civil society to foster innovation. ^H The points of overlap in the center represent the collaborative space where the four key actors come together. This is where the magic happens – the exchange of ideas, resources, and expertise that fuels innovation across the entire ecosystem.

Academia plays a pivotal role as it advances research, technological innovations, and theoretical frameworks. ^H The private sector drives commercialization introduces competitive dynamics and



implements practical applications. The government supports the ecosystem by providing policy support, funding, and regulation, creating an environment conducive to innovation. Civil society supports the ecosystem through NGOs, media, and the public, which offers insights into societal needs and ensures broader knowledge and acceptance of innovations. ^M

Figure 1. The Quadruple Helix Model depicts the interconnectedness of Government, Private Sector, Academia, and Society, working collaboratively to foster innovation and develop new ideas and concepts (https://www.researchgate.net/figure/Developed-notion-of-a-Quadruple-Helix-innovation-system_fig3_257796311)

This model promotes a synergistic approach in which the intertwined efforts of these diverse stakeholders not only accelerate the pace of technological advancement but also cultivate the

development of new ideas and concepts.^M Empirical studies demonstrate this assertion, revealing a marked uptick in innovation rates and a notable enhancement in technological efficacy, thereby attesting to the unparalleled value of collaborative interplay increasing innovation. Research of thirty case studies across various countries indicates those with cross-sector collaboration between academia, government, and private sector had increased innovation.^H One example is the UK Ministry of Defense (MOD) engaged academia, industry, and research organizations through Wazoku's Challenge Driven Innovation to solve defense and security challenges, such as the "High Altitude Challenge" aimed at improving disaster relief efforts. This collaboration brought together diverse expertise, fostering solutions that significantly enhanced operational capabilities. ^M

Academia in Innovation

In the future landscape of military innovation, the crucial role of both military and civilian academia as the cornerstone for theoretical advancements and cutting-edge research is undeniable. Historically, military organizations that have engaged deeply with the academic sector within the quadruple helix system have shown a marked increase in innovation and adaptability. This success originates from academia's pivotal role in pushing knowledge boundaries, challenging conventional wisdom, and pioneering novel theoretical frameworks and technologies. ^{MM} As the pace of technological development accelerates, the partnership between military organizations and academia becomes increasingly essential.

An example of effective cross-sector collaboration is the Manhattan Project, which brought together the military, academia, and the private sector, including top physicists, engineers, and corporations. Academic institutions such as the University of Chicago, Columbia University, and the University of California provided foundational research, laboratories, and scientific leadership[™] Academia served as the birthplace for theoretical frameworks, future technology, ideas, and concepts. This held true not only for civilian universities but also for military academies. Leveraging the personnel, laboratories, experimentation capabilities, theories, and pushing knowledge boundaries with the development of new ideas and concepts will become even more crucial in the coming years.

To fully harness the power of academia in military innovation, a robust PME system is essential. PME fosters a culture of innovation by equipping officers with critical thinking skills, technological literacy, and understanding of complex systems necessary for identifying and championing new ideas. Curricula that emphasize collaboration, interdisciplinary approaches, and exposure to cutting-edge research will prepare future leaders to navigate the rapidly evolving technological landscape. Additionally, PME can bridge the gap between theory and practice by incorporating wargaming simulations, case studies of successful civilian-military partnerships like the Manhattan Project, and opportunities for collaboration with academic researchers. By fostering a generation of officers with a deep understanding of both military doctrine and the latest advancements, PME education serves as the critical link between academia and real-world innovation within the military.

Private Sector in Innovation

In the quadruple helix model of innovation, it is equally important for military organizations to seek collaboration with the private sector, especially with the anticipated rapid development and complexity of technological advancements. The Manhattan Project serves as a testament to the significant impact of joint efforts on overcoming complex challenges and pushing technological boundaries. Companies like DuPont and General Electric were instrumental in developing essential infrastructure and components for nuclear research and bomb production, showcasing the private sector's capacity to transform academic research into scalable, practical solutions. ^M This blend of innovative scientific research and practical military applications exemplifies the innovation ecosystem framework's essence, where diverse expertise and resources unite to address complex challenges.

During the 1930s, the British military took the lead in bringing academia and the private sector together to develop the radar system, recognizing the need for an early warning system. ^M The military initiated and coordinated the collaboration among these diverse actors, playing a crucial role. ^M The private sector, including companies such as Metropolitan-Vickers and the Radio Research Station at Slough, contributed their expertise in the practical application and production of radar systems. ^M Through the military's leadership and coordination, these collaborative efforts resulted in the successful implementation of the radar system, which played a pivotal role in defending Britain during the Battle of Britain in World War II^{-M} This case study exemplifies the power of cross-sector collaboration in driving innovation and technological advancements within the military, reinforcing the argument that increased collaboration across academia, the military, and the private sector facilitates higher levels of innovation and adaptability, even in the face of significant challenges and technological advancements.

The development of the Global Positioning System (GPS) demonstrates the benefits of creating a strong synergy and shared vision can result in significant technological advancements that benefit the military and society. The military established the Joint Program Office under the Air Force, positioning it as the overarching Department of Defense (DOD) lead element that ensured a shared vision for the GPS and coordinated its operation and maintenance with partners from industry and academia. ^M The inclusion of industry and academia in the GPS development showcased a model of collaboration that effectively harnessed each sector's strengths to achieve a common goal. Far from being mere contractors or consultants, industry and academia served as integral partners in the development process. ^M Academia was crucial in training the engineers, scientists, and technicians who went on to contribute to the GPS project. Academic institutions also frequently acted as consultants or partners in research initiatives, offering their intellectual resources to address specific technical challenges encountered during the development of GPS.

Research departments within academia carried out essential research in fields like atomic clocks, signal processing, and orbital mechanics, all of which were vital for the accuracy and reliability of GPS.^M The specialized knowledge and skills acquired through academic programs provided individuals with the expertise required to navigate the complex challenges of developing a global navigation satellite system. ^M This collaborative approach not only accelerated the technological development of GPS but also ensured its adaptability and relevance across various domains.

The GPS project demonstrates how a shared vision, bolstered by cross-sector collaboration, can lead to groundbreaking innovations with a profound and lasting impact on society and the world. The private sector developed and manufactured the satellites and technology required for the GPS and ground control systems. As GPS technology matured, private companies introduced new applications and devices leveraging GPS for commercial and civilian purposes, thereby broadening the system's impact and utility. This symbiotic relationship led to the continuous enhancement of technology and its adaptation to emerging markets. The aerospace industry, including companies such as Rockwell International) Lockheed Martin, and Northrop Grumman, undertook the design, construction, and deployment of the satellites. ^H This effort underscored the critical role of the private sector in the successful realization of the GPS project.

Quadruple Helix Model and Cross Collaboration in the Future

Studies have shown that the DOD lacks a department-wide network mechanism for DOD innovators to connect, engage, share learnings and problem solve. $\overset{\text{H}}{=}$ While the DOD has many innovation champions; most operate in minor and often unrelated networks due to the lack of an

Characteristics of Innovation Scaling Network
Ecosystem Approach: Describing the network as an ecosystem for innovation highlights the interconnectedness and
interdependence of all stakeholders. A true partnership, where the success of one is linked to the success of all.
Cross-Sector Collaboration: It involves various stakeholders, including the military, private sector, and academia, working together.
This indicates a partnership that transcends organizational and sectoral boundaries, aiming for a common goal or vision.
Shared Vision and Goals: All parties involved align around a common purpose and shared objectives, ensuring that efforts are
concerted and directed toward mutual benefits.
Leadership and Governance: Effective leadership guides the network's activities, while clear governance structures ensure
accountability and decision-making efficiency.
Open Communication: The emphasis on a strategic framework that prioritizes open communication underlines the partnership's
foundation on transparency, trust, and continuous dialogue among all participants.
Leveraging Unique Strengths: The network's approach to leveraging each collaborator's unique strengths and insights indicates a
partnership that values diversity and recognizes the contributions of each member. This is fundamental to a true partnership.
Democratizing Innovation: By establishing platforms that invite new entrants from academia and the private sector, the network aims
to democratize innovation. This inclusivity is a partnership, ensuring that opportunities for contribution and benefit are available.
Problem-Solving and Transition Planning: The focus on problem-solving and fostering early transition planning highlights a
partnership that is action-oriented and focused on achieving practical results. It indicates a commitment to moving beyond discussion
to implementing solutions that have real-world impact.
Innovation Champion: This role spearheads innovation, advocating for new ideas and fostering their adoption across the military,
academia, and private sectors. They are pivotal in energizing the network, ensuring that collaborative efforts translate into solutions.

innovation scaling framework at the Joint Force level. In the future, successful military organizations will need to foster crosssector collaboration, aligning stakeholders to a unified mission and shared goals within a strategic framework that

Figure 2. Characteristics of Innovation Scaling Network

emphasizes open communication and collaboration (See Figure 2). ^{HH} Early collaboration on areas of interest, adopting coordinated approaches to technology, scouting, and sharing challenges, will create a common understanding of innovation requirements, leveraging each collaborator's unique strengths and insights.

In the future, forces with a defense innovation ecosystem that brings innovators closer to the warfighter and can rapidly adopt and scale innovative solutions will have a greater advantage. ^H Establishing platforms for new entrants from academia and the private sector not only democratizes innovation but also ensures a broader range of solutions to pressing defense problems. Emphasizing problem-solving and fostering early transition planning is essential for integrating cutting-edge research, technological prowess, and innovative methodologies into actionable and impactful military capabilities. ^H

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Perplexity, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, the future changes in technology, changes to the innovative ecosystem, and the understanding of the future environment, this report is sensitive to change due to new information.

Author: Krista J. Gueller

Independent Thinking During the Interwar Period (1918-1939) Paved the Way for New Innovative Military Doctrines

Executive Summary

It is highly likely (71-85%) that independent military thinkers, characterized by their willingness to challenge existing doctrines and envision new concepts in warfare, will produce desirable military innovations. This is due to the historical examples found in the Interwar Period, and that advantage goes to militaries that create officers with suitable amounts of battlefield experience, high intellect, exposure to diverse military cultures, and who possess the "Elasticity of Mind" to foresee the evolving character of warfare. This will be true despite the anticipated tensions within military organizations between forces that seek to maintain the predictable patterns of training and doctrine and those that embrace innovation, allowing for dynamic change and adaptation.

Discussion

Military innovations have often resulted from individuals or teams who thought outside the conventional frameworks of their time, challenging established norms and doctrines. These "Independent Thinkers" could break with traditional thought, use their unique analytical minds to enhance their problem-solving skills, and adapt new technologies into more potent military warfighting concepts and doctrine, demonstrating elasticity of mind.

In the early 20th century, the concept of aerial warfare was in its nascent stages. It was initially



Figure 1. Brigadier General Billy Mitchell in the cockpit of a Thomas Morse Pursuit Plane. Photo: Bettmann/Getty Images (https://www.gettyimages.co.uk/detail/newsphoto/brigadier-general-billy-mitchell-in-cockpit-of-athomas-news-photo/515511930)

met with skepticism and was relegated to the margins of military strategy. However, against this backdrop of preference for traditional warfare doctrines, Major William "Billy" Mitchell emerged as a pivotal figure. His foresight and relentless pursuit of aerial dominance challenged conventional military paradigms. He paved the way for a new era in warfare, leaving an indelible mark on the future of military strategy. ^M

Before the U.S. Army establishment fully embraced aerial warfare, Mitchell advocated using aircraft (biplanes) in roles beyond mere reconnaissance, including bombing and air superiority missions. His experiences in the

Philippines observing the Russo-Japanese War and during World War I at the Battle of Saint-Mihiel is where he witnessed the beginnings of air power on the battlefield. By 1918, he was promoted to Brigadier General and returned from Europe to the United States, actively challenging the status quo and confronting military doctrine with his ideas on Air Power. His public criticism of the U.S. military's unpreparedness for modern air warfare and the lack of investment in air power was controversial and unpopular. ^M By the 1920s, within the ongoing service arguments of roles and responsibilities involving coastal defense, Mitchell executed demonstrations of battleship bombing effectiveness to highlight the Army Air Service's potential and his prominence as an independent thinker. ^H These air demonstrations contradicted the traditional belief that Navy fleets were the ideal response to enemy fleets operating near the homeland.



Figure 2. On June 21, 1921, U.S. Army Air Service pilots bombed the captured German battleship Ostfriesland to demonstrate the effectiveness of aerial bombing on warships. At the time, the ship was one of the world's largest war vessels (https://www.airandspaceforces.com/article/billy -mitchell-ostfriesland/)

Mitchell's potential impact upon the U.S. military was cut short in 1925 when he was courtmartialed for accusing military and naval leaders of incompetence and "almost treasonable administration of the national defense" following the Navy dirigible Shenandoah disaster. ^M Mitchell's belief in the potential of air power and his contributions to its strategic development underscore a crucial lesson: the importance of visionary leadership in adapting to technological advancements and reimagining warfare in the modern age.

Another independent military thinker during this period is Marshall Mikhail Tukhachevsky. He helped to create a revolutionary approach to military strategy, with a keen focus on combined arms operations, marking a significant departure from the traditional doctrines of Russian military forces. Tukhachevsky foresaw the future of warfare as requiring a synthesis of speed, technology, and coordination that would come to dominate battlefields long after his execution in June 1937 as part of Stalin's military leadership purge.

Tukhachevsky was a strong proponent of combined arms operations, which involved integrating different military branches (infantry, armor, artillery, and air forces) in a unified, coordinated manner to achieve a tactical advantage on the battlefield. His experiences during the Russian Civil War and the early Soviet-Polish conflicts highlighted the importance of coordination among various military branches, leading to his advocacy for a more integrated approach to warfare. ^M These ideas were even tested in secret between Germany and Russia as early as 1922 when Russia allowed Germany to conduct secret military training within its borders on the condition that the knowledge, technology, and doctrine borne from these activities be shared.

Tukhachevsky understood that rapid movements and the ability to outmaneuver the enemy could lead to decisive victories. ^M This was a departure from the static trench warfare that characterized much of World War I, and these ideas emerged within the later developments in mechanized warfare used during World War II.

By the mid-1930s, his concept of "deep battle" (glubokiy boi) was fully developed and recorded into the Red Army's regulations. This concept envisioned a series of coordinated, large-scale attacks involving all arms of the military to penetrate deep into enemy territory,



Figure 3. The Deep Operation for Penetrating and Crushing a Front (https://www.armyupress.army.mil/Portals/7/combat -studiesinstitute/images/LSCO%20DeepOps%20book%20int

eractive%20with%20cover%20spread%2012Nov21. pdf)

thereby disrupting their ability to respond effectively. Concurrently, "deep operations" (Glubokaya operatsiya) aimed at destroying the enemy's strategic depth rather than merely engaging their front-line forces. ^M Tukhachevsky recognized the growing importance of technology in military strategy. He advocated for the modernization of the Soviet Red Army, including the development of armored forces, mechanization, and the innovative use of airpower. ^M His forward-thinking approach to the application of technology in warfare underscored his independence as a military thinker.

Tukhachevsky was unafraid to challenge established doctrines and push for radical changes in military thought. ^M His readiness to propose and implement innovative strategies, even when they conflicted with prevailing military doctrines, demonstrated his intellectual courage, and laid the groundwork for the modern military strategies that shape Russian strategy today.

Mitchell and Tukhachevsky had extensive military battlefield experience, high degrees of intelligence, and exposure to foreign militaries and cultures. As independent thinkers, their ability to foresee the changing nature of warfare and advocate for doctrines and strategies that broke with traditional concepts, emphasizing mobility, technology, and the integration of various arms of the military in a cohesive operational art made them some of the most influential military theorists of the 20th century.

In both cases, the US military and Soviet Red Army abruptly ended the influence these military leaders exerted upon the organizations before they could see their concepts adopted. This fact points to a need for military organizations in the 21st century to create a culture that allows

independent thinkers to challenge, experiment, and innovate new doctrine as new technologies enable new capabilities. Moreover, independent thinkers must also learn from these examples how to challenge organizational norms effectively without causing the permanent loss of their influence.

The rapid pace of technological advancement necessitates continual doctrinal adaptation. Just as airpower and mechanized warfare revolutionized military strategy in the past, cyber warfare, artificial intelligence, and unmanned systems are the modern equivalents demanding doctrinal innovation.

As BG Shane Reeves (US Army) stated in a 2023 War on the Rocks commentary article, "We know that innovation, driven by the thinking officer, is critical to fighting and winning the nation's future wars," ^M Further analysis shows that these gifted officers must be supported by innovation champions skilled in successfully guiding ideas into organizations and managing organizational change. These champions can prevent "thinking officers" from being removed from the organization before their impact is realized.

Analytical Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from many respective academic and research authors, and tended to corroborate one another. However, sources with detailed knowledge of PRC & PLA budgets are minimal. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Douglas Simmons

Revolutionizing Warfare and Education: Preparing Military Minds for Tomorrow's Challenges

Executive Summary

Education is highly likely (71-85%) to be a pivotal factor in fostering innovation and conceptual breakthroughs period. Given the rapidly changing character of warfare and the accelerated pace of technological advancements, military organizations that proactively adapt their education systems based on the changing character of war are likely to achieve higher rates of innovation and adaptability over the next 10-15 years. This focus on education, particularly when it encourages continuous learning, knowledge sharing, and exploring new ideas, is highly likely (71-85%) to cultivate a culture of innovation within the military.

Education's Pivotal Role in Fostering a Culture of Innovation

Innovation isn't just a matter of technology but also a matter of imagination, and education fuels that imagination.

- Admiral Mike Mullen, former Chairman of the Joint Chiefs of Staff Education plays a pivotal role in fostering innovation within the military by promoting adaptability and providing a foundation of knowledge. It instills a mindset of continuous

learning, encouraging military personnel to embrace new ideas, technologies, and methodologies .^M They gain this through exposure to a broad range of subjects and the exploration of diverse perspectives. ^M Such flexibility and openness to change are vital for effectively adapting to evolving threats and shifting operational environments. ^M Furthermore, education equips military personnel with a deep understanding of historical precedents, strategic concepts, and technological advancements, thereby serving as a platform for innovation ^M Armed with this knowledge, they can build upon existing expertise to develop novel solutions and adapt existing tactics to address new challenges.

During the interwar period, the transformative power of the German Panzer Corps' Blitzkrieg strategy and the British Navy's development of Q-ships during World War I stand as compelling evidence of education's pivotal role in driving military innovation and conceptual breakthroughs. These innovations were not mere products of serendipity but were deeply rooted in the systematic, forward-thinking approaches fostered by Professional Military Education (PME). The German General Staff's reform and emphasis on PME after World War I, included rigorous analysis of trench warfare shortcomings, integration of new technologies, and exploration of maneuver warfare theory, underscoring how education can prepare military minds for groundbreaking strategic developments. ^M

Similarly, the British Navy's ingenious creation of Q-ships, merchant vessels equipped with hidden weapons to ambush submarines, illustrates how education tailored to address specific challenges—such as asymmetric threats and the necessity for deception—can lead to innovative military solutions. In both instances, PME played a critical role in equipping military leaders with the analytical skills, technological understanding, and strategic thinking necessary to conceive and implement revolutionary tactics and strategies.

The rapid evolution of cyberwarfare in the 21st century exemplifies the critical need for adaptability in military education. Before 9/11, military academies primarily had their focus on traditional warfare. ^M In response to emerging cyber threats, the U.S. Military Academies proactively adapted their curricula to meet these challenges head-on. This cyber education focus actively equips cadets and midshipmen with the necessary knowledge and skills to navigate the digital battlefield. Courses in cybersecurity and cyber operations arm them with a deep understanding of cyber threats, defensive strategies, and offensive capabilities. By integrating cyber education across disciplines, the academies foster critical thinking, problem-solving, and collaboration, which are traits essential for innovation in this rapidly evolving domain. ^M

These examples underscore how education, especially when it fosters continuous learning, knowledge sharing, and the exploration of new ideas, can create an environment conducive to innovation within the military. Military organizations that actively revise their educational systems to reflect the evolving nature of warfare are more likely to foster a robust culture of innovation and adaptability in the next 10-15 years. However, it's crucial to acknowledge that a successful innovation environment also depends on a willingness to experiment and a culture that celebrates calculated risks.

Professional Military Education Develops Creativity and Adaptability

Professional military education is critical to the development of creativity, and strategic thought enabling service members to adapt and develop new methods, concepts, and adjacent applications. ^M Professional military education provides the foundation for theoretical frameworks, future technologies, ideas, and concepts. During the interwar period, the Naval War College played a pivotal role in fostering innovation and adapting to the changing character of warfare. It motivated naval officers to experiment and deepen their understanding of the strategic importance of power projection and sea control. This insight underscored the necessity for a mobile and adaptable naval force, fully capable of countering global threats; a task ideally suited for aircraft carriers.

Through its PME institutions, the U.S. Navy created an experimental learning environment that encouraged officers to explore innovative tactics and technologies. ^H The commissioning of USS Langley, Lexington, and Saratoga provided the Navy with platforms to test carrier design, aviation technology, and operational concepts. This hands-on learning approach nurtured a

profound understanding of carrier warfare's potential. ^M The collaboration between aviators trained at the Naval Air Station Pensacola and naval officers from the Naval War College fostered an environment for innovation. This cross-disciplinary collaboration sparked an exchange of ideas and experiences, culminating in the development of integrated carrier tactics and operations. By leveraging the insights and capabilities developed through these PME initiatives, the Navy not only cemented its position as a dominant maritime force but also established a precedent for integrating technological advancements into military strategy and operations.

A critical component of transforming professional military education involves identifying and developing innovation champions who embody traits such as critical thinking, vision, resilience, strategic communications, adaptability, and the courage to challenge conventional wisdom. ^{MM} These champions lead the military's intellectual and operational advancements, echoing the Naval War College's spirit of experimentation and strategic foresight during the interwar period or leaders like Giulio Douhet and Billy Mitchell advocated the decisive impact of air power. ^H

Today's innovation champions drive the integration of emerging technologies, interdisciplinary methods, and visionary strategies into military education and operations. ^M They foster an environment that values intellectual curiosity, enabling an exchange of ideas and ensuring the systematic incorporation of new concepts and technologies into military doctrine and tactics. ^H Developing and empowering innovation champions within professional military education is essential for the military to continue innovating and adapting in the face of an evolving global security environment.

Leveraging Technology

As technology advances, forces that leverage and experiment with Artificial Intelligence (AI), data analytics, and emerging technologies will increase their ability to adapt. Integrating these disciplines into the PME curriculum is crucial not only for enhancing operational effectiveness and strategic decision-making but also for maintaining a competitive advantage. Increasing the use and experimentation with these and future technologies within PME will provide experience and increased understanding of capabilities. This approach necessitates promoting an interdisciplinary method, hands-on training, continuous learning, and collaboration with industry and academia. Far from being merely a strategic advantage, this evolution is a critical step in preparing for the future fight.

Partnerships with Civilian Academia, Research Centers, and Industry

Over the next 10-15 years, PME institutions should intensify their efforts to forge robust partnerships with civilian universities, research centers, and industries. These strategic collaborations aim to enrich PME curricula with the latest knowledge, innovative teaching methodologies, and cutting-edge technologies by directly involving subject matter experts from
various fields. Such partnerships will play a crucial role in keeping the curriculum dynamic and in sync with the fast-evolving landscape of military operations^{.M} Civilian academic and research institutions, with their invaluable expertise in emerging domains like cyber warfare, artificial intelligence, and unmanned systems, alongside industry partnerships, will provide practical exposure to the latest technological advancements and their applications. ^{MM} that mirrors contemporary challenges, thus enhancing strategic decision-making and operational planning.

By embracing innovative educational methods, such as virtual reality and online platforms, these partnerships promise to cultivate engaging learning environments that promote a culture of continuous learning and adaptability among military personnel. ^M This approach is essential for sustaining a strategic advantage and operational effectiveness amidst the constantly shifting global security challenges.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Perplexity, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, the future changes in technology, changes to the objectives of academia, and the understanding of the future environment, this report is sensitive to change due to new information.

Author: Krista J. Gueller

Better Educated, U.S. Military Highly Likely to Maintain Advantage Against PLA Over Next 10-15 Years

Executive Summary

U.S. military leaders are highly likely (71-85%) to maintain an advantage over their Chinese People's Liberation Army (PLA) counterparts over the next 10-15 years due to a robust and historically significant military education system that encompasses a broad array of skills (tactical, operational, and strategic-level considerations, as well as both strategic studies and technical skills) that enable a combination of critical and creative thinking. Despite major reforms to Chinese military education in recent decades and increased foreign military education exchanges, China remains unlikely (31-45%) to overcome the U.S. military's education advantages within the next decade.

Discussion

Innovation within the military has long been linked to the educational development of its leaders.^{HH} The United States has a rich history of educating its military leaders, most notably its officer corps. The "marriage of military structure with education" is credited with 18th-century European roots; however, American schools sought to "produce informed individuals capable of being transformed into effective citizens of a democratic republic" rather than increasing social status.^M Many of the United States Founding Fathers, including George Washington, John Adams, and Thomas Jefferson, led the development of the country's earliest educational institutions, including the founding of the Military Academy at West Point in 1802, which remained the country's only engineering school until 1821.^M Since then, the United States has established nearly 850 military schools (more than any other nation), including the Naval War College in 1880, the Army War College in 1901, and the Naval Postgraduate School in 1909.^{MM}

German military leaders in the years preceding World War II were welleducated in dominating operational and tactical level campaigns; however, German military education lacked emphasis on civilian-military relations and strategic-level planning.^H Adolf Hitler's often irrational mismanagement of war efforts aside, German military leaders proved woefully ill-suited for ensuring that strategy linked operational and campaign objectives to achieving Grand Strategy aims.^H



Figure 1: German officers study maps in a military academy, 1935. Click on the picture or go to: https://www.armyupress.army.mil/Journals/Military-Review/Online-Exclusive/2021-OLE/Arensdorf/. Source: Army University Press

Likewise, French military education during the interwar period "mainly supported development and smooth implementation of the Methodical Battle concept rather than the preparation for the war itself and it did not support the realistic preparation for the up-coming war."^M

In comparison, U.S. military education institutions produced officers prepared to carry out a large-scale war. The U.S. Army War College curriculum in 1927-28 (Dwight D. Eisenhower's class) included a "thorough and rigorous curriculum, organized around war planning and the functions of the War Department and General Staff."^H Students were required to develop a "workable war plan" at the end of the academic year, as well as conduct research on "all manner of topics" and studies on "military intelligence, operations, logistics, mobilization, and war planning from a wide variety of functional, regional, historical, theoretical, civilian, allied, and joint perspectives."^H The organization of curriculum remained largely unchanged until the school closed its doors in Washington D.C. in 1940 after the outset of World War II.^H

The U.S. Army War College would not be re-established until 1950 (at Fort Leavenworth, then moved again in 1951 to its current location at Carlisle Barracks). The National War College was established in the old Army buildings in Washington D.C. in 1946 along with establishing the Armed Forces Staff College in Norfolk.^H In the decades that followed, the increasing drive to "broaden perspectives" forced incremental incorporation of various technical and social science fields as well as "more generic" objectives by which graduates were prepared.^H

The U.S. military currently maintains a wide variety of education programs. Schools both within and external to the DoD educate military leaders at all levels on topics such as (but not limited to): tactics, warfighting, planning, campaigning, language and culture, science, technology, engineering, mathematics (STEM), civilian-military relations, strategy, and international relations. Various schools maintain unique curricula, including service-specific considerations, while also incorporating universal concepts and joint professional education (JPME) requirements.^M For example, each War College varies in size and location and provides unique experiences, but all meet JPME phase II requirements and largely mirror top civilian strategic studies MA programs.^M The DoD also strives to maintain an innovative advantage, where educational initiatives such as U.S. Air Force Air University's "Blue Horizon" program provide "future-oriented study exploring military-technical and geostrategic competition and its implications for Air Force strategy and planning."^H

While the two terms are sometimes conflated, the U.S. military services maintain a distinction between training and education – the former to teach a particular skill or type of behavior and the latter using knowledge and development to teach a person *how to think*.^M Amidst a list of characteristics, U.S. military education institutions strive for their graduates to "demonstrate critical and creative thinking skills."^M Critical thinking is "the use of those cognitive skills or strategies that increase the probability of a desirable outcome," while creative thinking is "the

ability to produce novel ideas that others value."^{\mathbb{H}} Accounting for divergent and convergent approaches to problem-solving, both critical and creative thinking are crucial for tackling complex and wicked problems.^{\mathbb{H}} U.S. military leaders appear to maintain an advantage over PLA counterparts in the aspect of creative thinking.^{\mathbb{M}}

The U.S. military's performance during Operation Desert Shield and Desert Storm in 1990-91, as well as the 1996 Taiwan Strait Crisis, signaled to China the need to modernize the PLA, which included education and training reforms to improve personnel performance.^H Military education reforms included leveraging civilian educational institutions to "patch up its shortcomings in high-tech talent development," which yielded a significant increase in recruiting college graduates (~2,000 in 2003 up to ~150,000 in 2017). However, "newly admitted college student recruits in 2017 contained "basically no graduates of Program 211 and Program 985 universities," which are generally considered China's top civilian educational institutions."^H Additional reforms in 2017 included the cancellation of the National Defense Student Program as well as an overall reduction of military education institutions). ^HH

China's military education is also predicated on "inclusion of "political excellence" [which] underlines the leadership's continued concern about the political reliability of the PLA." $\underline{\mathbb{H}}$ Several historical instances highlight Chinese Communist Party (CCP) leaders' concerns in this area:

- (1) Power struggles between the CCP and PLA leaders during the Chinese Civil War in the 1930s and 40s.
- (2) Mao overruling PLA commanders in early 1950 to move troops north to the Korean border instead of the originally planned assault on Taiwan.
- (3) Mao deposing and punishing a military commander, Peng Dehuai, for "speaking truth to power."
- (4) PLA underperformance against Vietnamese forces in 1979.
- (5) Perceived PLA incompetence and untrustworthiness during the 2001 China-U.S. Hainan Island incident.^{\underline{H}}

The resulting organizational culture "has favored the army over other services, fostered a lack of initiative and creativity within the officer corps, and discouraged risk-taking."^H While reforms under Xi Jinping seek to improve civil-miliary integration, joint education, and creativity within the PLA, maturation of his reforms have yet to yield notable results.^{HH}

China also seeks to strengthen its international agreements through personnel exchanges within its PME institutions. According to a recent Journal of Indo-Pacific Affairs article, China views "PME [as] an efficient means to advance partnerships, as it is a confidence-building measure...through academic engagement, justifies mechanisms of regular consultations...to establish and renew exchanges, and enables military-technical cooperation/personnel exchanges..."^H Associated curriculum includes five key areas: "history and culture of China, military thought from Sun Tzu's The Art of War to modern theory and tactics, research on strategic problems and the national defense system, technical skills in mission command, and China's military capabilities and national defense construction."^H The article also points out that "while some courses aim to expose [Latin American and Caribbean] military students to Chinese



Figure 2: Ladder of military cooperation. Click on the picture or go to: https://doi.org/10.1057/s41311-019-00178-8. Source: Springer.com

doctrine, it has been observed that "the war college course on offer in China [is] in actuality a copy of U.S. doctrine translated into Spanish" and further asserts that "this may be attributed, at least in part, to gaps in Chinese doctrine and joint-level operations."^H Overall, PLA education reforms and foreign exchanges are unlikely to meet the United States PME advantages within the next decade.

Analytical Confidence

The analytic confidence in this estimate is *moderate*. Sources are generally reliable, with many historically grounded topics that have been well-studied for many decades. There was ample time for research, which was conducted individually. However, given the lengthy time frame of the estimate and the limited information regarding PLA doctrine and education, this report is sensitive to change based on the potential efficacy of China's military education reforms.

Author: Kelly M. Raisch

Shaping Future Leaders: The Role of Cognitive Flexibility (Elasticity of Mind)

Executive Summary

"Elasticity of mind," or cognitive flexibility, is highly likely (71-85%) to be a success indicator for exceptional leadership and innovation in the military and technology sectors. Despite the inherent complexity of enhancing neurogenesis and the need for tailored cognitive training programs, cultivating this trait presents challenges. A Multi-Criteria Decision Making analysis provides a structured approach, emphasizing the importance of measuring cognitive flexibility (90%), predicting cognitive flexibility potential (70%), applying a comprehensive cognitive training program (95%), and promoting an innovation culture (80%). This inclusive strategy is critical for equipping leaders to view problems from multiple angles, rapidly create or champion innovative solutions, and adapt strategies in an ever-changing global context.

Discussion

"Elasticity of mind," or cognitive flexibility, refers to the capacity of an individual to adapt their thinking and behaviors in response to new, changing, or unexpected events. This encompasses shifting perspectives, experimenting with different approaches, and navigating through uncertainty with agility. Cognitive flexibility enables recognizing and exploiting opportunities beyond traditional paradigms, embodying a proactive approach to innovation and problem-solving.

In the rapidly evolving 21st-century landscape, cognitive flexibility emerges as a crucial trait for military leadership. The ability to generate diverse solutions to complex problems, often measured through divergent thinking, has shown a likely (56-70%) relationship with leadership effectiveness. ^M This capacity is particularly vital for military leaders who must navigate the multifaceted challenges of modern warfare, including technological advancements, asymmetric threats, and shifting geopolitical dynamics. Cognitive flexibility underpins the capability to devise novel strategies, adapt to unforeseen circumstances, and maintain operational agility.

In the interwar period, the concept of cognitive flexibility was vividly embodied by military strategists like General Heinz Guderian and Giulio Douhet, who sought innovative solutions to the problems posed by contemporary warfare. Guderian addressed the issue of the static and attritional nature of World War I combat by developing the Blitzkrieg strategy. ^H This approach, which emphasized rapid movement, coordination among tanks, aircraft, and mechanized infantry, and the exploitation of operational breakthroughs, represented a paradigm shift from the entrenched defensive tactics of the past. ^H His advocacy for decentralized command within this strategy, as elaborated in "Achtung – Panzer!" aimed to maximize the effectiveness of these fastmoving armored units. ^H Similarly, Douhet tackled the challenge of overcoming entrenched ground defenses by proposing the importance of air power in future conflicts. ^H In "The

Command of the Air," he argued that control of the skies and strategic bombing could directly target an adversary's industrial and civilian infrastructure, thus bypassing traditional battlefield confrontations altogether. ^H Douhet envisioned the strategic use of air power to break the enemy's will, a concept far ahead of its time, given the limited role of aircraft in World War I.

Both Guderian and Douhet exemplified cognitive flexibility by championing military strategies that broke away from the conventional doctrines of their time. They each introduced visionary approaches to warfare that were predicated on overcoming the present challenges and limitations faced by military tactics. Their efforts not only reflected personal adaptability but also contributed to cultivating an innovation culture within the military.

Elon Musk, Jeff Bezos, and Steve Jobs exemplify the transformative impact of cognitive flexibility in technology. Musk tackled space travel's high cost and unsustainability with SpaceX by pioneering reusable rocket technology, challenging aerospace norms. ^H At Tesla, he redefined the automotive industry's approach to electric vehicles, making them desirable and performance-driven. Bezos revolutionized retail through Amazon by leveraging the internet to change shopping habits globally. Later, it ventured into space exploration with Blue Origin, aiming to make space travel accessible. ^M Jobs, through Apple, merged technology with design, creating intuitive and integrated devices like the iPhone, which changed how we communicate and interact with technology. These innovators saw beyond the constraints of their times, applying creative solutions to complex problems. Their achievements underscore the crucial role of cognitive flexibility in technological advancement and industry transformation, showing how visionary thinking can lead to significant societal shifts.

Cognitive flexibility hinges on complex brain functions, notably involving neurogenesis, the creation of new neurons, and the integrated activity of brain networks in the prefrontal cortex, which are central to executive functions like decision-making and social behavior modulation. ^M This flexibility is crucial for adapting to novel information, rethinking problems, and devising unique solutions. Neurogenesis enhances the brain's adaptability, which is pivotal for memory and learning, with research indicating that stimulating environments and learning boost this process. ^M

Activities that challenge the brain, from learning new skills to physical exercise, are linked to



Figure 1. Prefrontal Cortex and hippocampus (https://www.psychologytoday.com/intl/blog/childsleep-zzzs/201302/the-prefrontal-cortex-during-sleep)

increased neuron production in the hippocampus, which is vital for memory and learning. ^M The cycle between cognitive flexibility and neurogenesis is mutually reinforcing; as neurogenesis improves neural adaptability, it promotes more dynamic thinking and problemsolving, while cognitive challenges stimulate neurogenesis, improving overall brain function. ^M Cognitive flexibility also ties to the dopaminergic system, with dopamine levels in the prefrontal cortex affecting adaptability to new tasks and



Figure 2. Neurogenesis is the process by which new brain cells or neurons are formed, contributing to the brain's development and adaptability. Photo courtesy of Adobe Stock.

environments. ^{\pm} Balanced dopamine levels are essential for fostering creativity and flexible thinking, whereas imbalances may lead to rigidity. ^{\pm} Understanding this interplay offers insights into brain adaptability and implications for cognitive enhancement throughout life. Encouraging neurogenesis and a balanced dopaminergic system could bolster cognitive flexibility, improving creativity, problem-solving, and navigation of complex scenarios.

Cognitive flexibility is assessed through psychological tests and subjective measures, such as the objective Wisconsin Card Sorting Test (WCST) and the self-reported Cognitive Flexibility Scale (CFS). ^H These tools gauge an individual's capacity to modify their cognitive strategies and approaches to problem-solving when faced with new or evolving environments and rules. ^H Predicting cognitive flexibility extends beyond mere assessment; it involves a comprehensive understanding of the various elements contributing to its development, including genetic factors, environmental influences, and educational backgrounds. Employing neuroimaging techniques

alongside cognitive evaluations can shed light on a person's cognitive flexibility, facilitating the recognition of individuals who possess the potential to become leaders and innovators by navigating complex challenges with adaptability and foresight. ^M



Figure 3. Wisconsin Card Sorting Test (WCST) (https://www.hogrefe.fr/le-standard-del%E2%80%B2evaluation-du-fonctionnement-executif/)

Cognitive flexibility is highly likely to be improved by engaging in a regimen that enhances the brain's adaptability to new challenges through neuroplasticity (the brain's ability to reorganize itself by forming new neural connections). This regimen includes cognitive exercises, physical activities, and mindfulness meditation to boost adaptability and resilience. Exercises such as the WCST challenge the brain to adopt new strategies and solve problems, enhancing flexibility. Learning new languages or musical instruments improves critical executive functions for cognitive flexibility. ^{MM} Mindfulness meditation focuses on the present, enhancing the prefrontal cortex's role in complex behavior and decision-making. ^{HMM} Integrating these approaches maximizes benefits, thoroughly addressing cognitive flexibility to better prepare individuals for changing environments and challenges.

To enhance cognitive flexibility and cultivate elite leaders with advanced cognitive skills in the military over the next 10-15 years, a holistic strategy is essential. This involves identifying individuals who possess a high potential for cognitive flexibility early in their careers. This can be done through cognitive assessments and neuroimaging techniques. Upon identifying these military officers, it's crucial to concentrate on honing their abilities within their initial 2-5 years of service. Training efforts during this phase, especially during O-3 and O-4 professional military education, should be directed towards amplifying their problem-solving capabilities, nurturing creative thinking, and enhancing adaptability. Encouraging engagement with various experiences and promoting interdisciplinary learning will stimulate neurogenesis and increase cognitive agility.

To foster cognitive flexibility, it is crucial to establish a culture that values experimentation and learns from failures. Encouraging the exploration of new approaches to military operations and strategy is essential to drive this innovation culture shift. By applying cognitive flexibility in real-world scenarios, the military can remain adaptive and innovative in the face of future challenges.

A Multi-Criteria Decision Making (MCDM) analysis for nurturing senior military leaders with exceptional cognitive flexibility outlines a strategic approach based on four core criteria: measuring cognitive flexibility (almost certain, 90%), prediction of cognitive potential (likely, 70%), the application of a cognitive training program (almost certain, 95%) training program, and the promotion of an innovation culture (highly likely, 80%). The predictive phase examines genetic, environmental, and experiential factors through advanced techniques like neuroimaging to identify individuals with high adaptability for leadership roles. The cognitive training program

spans early education to senior officer training, focusing on enhancing problem-solving, and adaptability through interdisciplinary learning and activities that promote neurogenesis. The final criterion highlights the importance of fostering an innovation culture that supports creativity, learns from failures, and encourages the exploration of novel solutions to challenges. This strategy aims to develop military leaders capable of navigating modern warfare and strategic planning with advanced cognitive flexibility.



Figure 4. This radar chart underscores the balanced approach required to cultivate exceptional cognitive flexibility among military leaders.

Analytic Confidence

The analytical confidence for this estimate is *moderate*. Sources were reliable, from a multitude of respective academic authors, and tended to corroborate one another. Sufficient time was available for the analyst to review academic writings, and an Artificial Intelligence (AI) text-to-text program was used to assist with research questions.

Author: Michael McCray

Codebreaking's Enduring Legacy: Interwar Innovations Highly Likely to Influence Computational Security in the next 10-15 years

Executive Summary

It is highly likely (71-85%) that the principles (Frequency Analysis) of codebreaking forged during the interwar period (1919-1939) will continue shaping pivotal technological advancements over the next 10-15 years, particularly in Artificial Intelligence (AI), digital ecosystems, and mathematical trust within computational systems. British successes in cryptography and cryptanalysis during this era highlight the enduring importance of these fields for future challenges. Despite evolving threats, unpredictable breakthroughs, and the complexities of AI implementation, it is highly likely (71-85%) that AI will progressively automate cryptography and cryptanalysis, enhancing the speed and efficacy of U.S. efforts to outpace adversaries.

Discussion

Due to the development of the theoretical Turing machine during the interwar period, a foundational pillar of computation theory emerged, profoundly influencing modern AI advancements. ^M The emphasis on logic, automation, and pattern recognition during the interwar period fostered a scientific and technological environment that continues to fuel advancements in AI research. The interwar period's legacy lies not only in specific codebreaking techniques but also in the broader intellectual and methodological frameworks that continue to shape the field of AI. ^H

The U.S.'s software, cloud infrastructure, and AI leadership place it at the forefront of shaping global digital ecosystems, offering economic advantages and national security implications. In line with Deputy Secretary of Defense Hicks's statement, "As we've focused on integrating AI into our operations responsibly and at speed, our main reason for doing so has been straightforward: because it gives us even better decision advantage than we already have today.", AI provides a decisive edge. Within 10-15 years, AI and digital ecosystems will likely revolutionize wargaming and military decision-making processes, emphasizing verification, validation, data integrity, and provenance. ^M Digital ecosystems enable the DoD to seamlessly collect, integrate, and analyze massive data flows from various sources, enhancing operational efficiency and situational awareness for well-informed and timely decisions at every level. ^H

Despite the transformative potential of AI, navigating the complex realities of the 21st century presents several challenges for the United States. Unlike the United Kingdom during the interwar period, where codebreaking was a singular, unifying national priority, the U.S. faced a multitude of competing priorities and resource allocation constraints. Bureaucratic hurdles can significantly hinder research and development efforts, potentially slowing down the pace of crucial advancements in AI. \underline{H}

To maintain its technological edge, the United States must prioritize proactive strategies addressing encryption vulnerabilities in traditional computing. Adversaries' use of "harvest now, decrypt later" tactics, along with the looming threat of quantum computing, underscore the urgency of this effort. ^H AI will play a crucial role in identifying patterns and weaknesses in encryption algorithms, enabling the United States to stay ahead in the global innovation race. ^H



Figure 1. Enigma machine. Since 1918, the Germans have been using Enigma ciphers as the core of their intelligence and military communications system (tps://www.theguardian.com/technology/2014/n ov/14/how-did-enigma-machine-work-imitationgame)

Turing's groundbreaking work, born in the crucible of the interwar period, continues to shape the landscape of AI today. While challenges persist in navigating the complexities of the 21st century, the United States has a unique opportunity to leverage its strengths in research and innovation to maintain a competitive edge. By strategically allocating resources and fostering an environment conducive to safeguarding this advantage, the United States can ensure a future where AI is a powerful tool for national security and global advancement.



Figure 2. Futuristic robot artificial intelligence revolutionary. Photo courtesy of freepik.com (htps://www.freepik.com/premium-photo/futuristic-robotartificial-intelligence-revolutionary-ai-technologyconcept_28502582.htm)

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources were reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Gemini, and Grammarly were used, but all results were reviewed, further researched, and validated against sources. However, given the lengthy time of the estimate, the future changes in technology, and the understanding of Artificial Intelligence, this report is sensitive to change due to the latest information.

Author: Noel D. Chun

The Blitzkrieg of the 21st Century: Drone swarms Highly Likely to disrupt and revolutionize every domain by 2038

Executive Summary

Drone swarms are highly likely (71-85%) to transform defense mechanisms and military strategies spanning land, air, sea, and cyber domains by 2038. This breakthrough technology, distinguished by its capacity for operational effectiveness, strategic flexibility, and considerable force multiplication, is poised to challenge established military paradigms. Rapid advances in artificial intelligence, downsizing, and stealth technologies have fueled an unprecedented spread of drone swarms, giving asymmetrical benefits to various actors, from small governments to non-state entities. Their emergence is highly likely (71-85%) to hinder the establishment of effective counterstrategies and defense systems. The complexity of fighting such powerful technologies requires rethinking existing military doctrines and developing new techniques to protect against this sophisticated threat.

Discussion

Drawing parallels from the interwar period, a time marked by rapid technological advancements and doctrinal shifts post-World War I, we observe similar patterns emerging with drone swarm technologies. The interwar period was characterized by developing and integrating mechanized warfare, airpower, and combined arms tactics, fundamentally transforming military strategies and capabilities. \underline{H} In a contemporary context, drone swarm technologies epitomize a comparable technological leap, poised to redefine warfare in the air, land, sea, cyber, and space domains by 2038.[™]

Drone swarms, with their autonomous coordination and large numbers, offer unique advantages in military operations. $\stackrel{\text{H}}{=}$ Despite their intrinsic



Figure 1. Drone Swarm

(https://stock.adobe.com/search?creator_id=200404573&filters%5Bcontent_ty pe%3Aphoto%5D=1&filters%5Bcontent_type%3Aillustration%5D=1&filters%5 Bcontent_type%3Azip_vector%5D=1&filters%5Bcontent_type%3Avideo%5D=1 &filters%5Bcontent_type%3Atemplate%5D=1&filters%5Bcontent_type%3A3d %5D=1&filters%5Bfetch_excluded_assets%5D=1&filters%5Bcontent_type%3A image%5D=1&order=relevance&safe_search=1&k=drone+swarm&search_pag e=1&search_type=usertyped&acp=&aco=drone+swarm&get_facets=0&asset_i d=170466826)

properties of swarms—redundancy, resilience, and adaptability—it is highly likely (71-85%) that they will execute complex missions across multiple domains, potentially overwhelming

traditional defense systems. ^M The strategic deployment of drone swarms in surveillance extends the eyes and ears of military forces, offering real-time, high-resolution data across expansive areas without risking human lives. In electronic warfare, these swarms can disrupt enemy communications, radar, and navigation systems, creating a significant informational advantage and confusion among adversaries. Moreover, their capability for precise kinetic strikes allows targeted operations against critical assets while minimizing collateral damage and political fallout. ^M

The strategic advantages of drone swarms are further amplified by their cost-effectiveness and speed of deployment, challenging the existing military balance of power and compelling a thorough reassessment of defense doctrines and operational strategies. Integrating advanced AI algorithms enhances their decision-making capabilities, enabling them to autonomously adapt to dynamic combat scenarios. This evolution signifies a shift towards more asymmetric warfare tactics, where smaller, technologically advanced forces can disproportionately affect larger traditional military structures. M



Source: GAO analysis (data). Sonar512/topvectors/stock.adobe.com (images). | GAO-23-106930

Figure 2. Drone swarm technology (https://www.youtube.com/watch?v=zq1ud7CBOaU)

Due to this emergent threat, it is highly likely (71-85%) that a timely, flexible, and comprehensive approach encompassing technological innovation, legal framework adaptation, and doctrinal evolution will be essential. ^H Technologically, the focus should be developing and deploying AI-driven countermeasures capable of autonomous operation to detect, track, and neutralize drone swarms effectively. ^H This includes investments in advanced sensor networks, electronic warfare capabilities for jamming and spoofing, and kinetic solutions such as directed

energy weapons, which offer a cost-effective response to the voluminous nature of drone swarms.

Legally, there is a pressing need to navigate and reform the existing statutory and regulatory landscapes that significantly hinder the deployment of effective counter-sUAS measures within domestic jurisdictions. Existing regulations for individual drones must fully address the complexities and potential dangers of swarms. ^M The use of drone swarms with lethal capabilities raises ethical concerns about machine-driven decisions in warfare. ^M Enhancing interagency cooperation and harmonizing legal frameworks to facilitate timely and decisive action against drone swarms is crucial. ^{HM}

Doctrinally, the armed forces must reassess and adapt their operational concepts and tactics to address the unique challenges posed by drone swarms. This entails thoroughly examining current air defense and force protection strategies, integrating new counter-sUAS technologies, and developing specialized training programs for personnel. M

The forecast of drone swarms as a transformative element in warfare by 2038 necessitates a nuanced analysis beyond surface-level observations. The analogy drawn from the interwar period's technological and doctrinal shifts underscores a cyclical pattern in military evolution, where technological leaps catalyze fundamental changes in warfare strategies. These parallels invite a critical examination of how contemporary military thinkers are preparing for the impending paradigm shift that drone swarm technology represents. The multifaceted advantages of drone swarms—spanning operational effectiveness, strategic flexibility, and force multiplication—highlight a dual-edged sword; they promise significant tactical benefits but also introduce complexities in developing countermeasures and adapting existing military doctrines.

Analytic Confidence

The analytic confidence for this estimate is *moderate*. Sources are generally reliable and corroborated with one another. The analyst worked alone and had adequate time to research. In addition to traditional research methods, ChatGPT4, Bard, Scispace, and Grammarly were utilized, and all results were reviewed, further researched, and validated against sources. However, given the lengthy time frame of the estimate, this report is sensitive to change due to new and rapid changes in technology and its integration of AI and ML.

Author: Noel D. Chun

Terms of Reference: Back to the Futures

For:

Lt. Gen. Dagvin R. M. Anderson Director, Joint Staff J-7

By:

Futures A-Team (Team Anderson) US Army War College

November 21, 2023

Terms of Reference:

Back to the Futures

Requirement

The team's research and analysis efforts will focus on answering the below project question and associated sub-questions:

What were the key conditions, factors, and lessons from the 1919-1939 interwar period (as well as other periods of transition) that influenced innovation and success in subsequent conflicts, and how can these insights inform Joint Force Design in the next 10 – 15 years?

- What factors enabled or facilitated the adoption and convergence of new/disruptive technologies toward implementing visionary concepts? Likewise, what challenges and barriers delayed or prevented this?
 - What culture fostered adaptation? What operational architectures and decision-making processes induced new strategic focus?
 - How were visions implemented? What made them successful or caused them to fail?
- •
- Regarding future Joint Force Design, how do these historical factors apply to the adoption and convergence of new/disruptive technologies toward the implementation of visionary and innovative concepts in the next 10-15 years?
 - What are the key lessons from both military and non-military examples that have successfully fostered the development and implementation of visionary concepts, specifically in enhancing the 'elasticity of mind'? How will these lessons predictively contribute to further enhancing this 'elasticity of mind' among individuals, organizations, and cultures, thus enabling them to adapt innovatively to changing circumstances and to foresee and navigate future challenges effectively?
 - What individual attributes and skillsets are predicted to become increasingly crucial for the US Military in the next 10-15 years? What methods or approaches are forecasted to be most effective in educating and training personnel to harness the benefits of synthesizing and applying novel skills and ideas for national defense?

Methodology

The team will approach the project along two lines of effort. The first line of effort will include historical case studies including (but not limited to) lessons drawn from the interwar period of the 20th century. The second line of effort will seek to apply historical lessons drawn from the first line of effort toward forecasting the adoption and

convergence of emerging concepts and technologies to inform Joint Force Design in the next 10-15 years.

Under the first line of effort, the team will conduct multiple case studies to explore innovative organizational adaptation (or failure to adapt) during periods of transition characterized by the adoption and convergence of emerging technologies.

- Case studies will include military lessons from the interwar period from 1919-1939.
- Case studies may also include lessons from other periods of transition, as well as non-military cases.

The second line of effort will explore and analyze emerging, potentially disruptive concepts and technologies that may contribute to reshaping the character of war over the next 10-15 years.

- Analysis will attempt to describe how lessons from the historical case studies in LOE 1 can inform the adoption and development (including convergence) of emerging concepts and technologies over the next 10-15 years.
- The team's analysis will explore multiple emerging (potentially disruptive) concepts and technologies that may include (but are not limited to) biotech, information technologies, hypersonic weapons, space systems, artificial intelligence, and quantum computing.
- Based on the above analysis, the team will attempt to identify aspects that may inform Joint Force Design within the next 10-15 years.

Tentative timeline and milestones:

- Late Nov Early Feb: Case study research and analysis (LOE 1).
- NLT 15 Dec: Project Sponsor reviews and approves Terms of Reference.
- Mid Dec Late Mar: Emerging concepts/technologies research and analysis (LOE 2).
- Mid Mar Mid Apr: Finalize analysis and findings.
- NLT 12 Apr: Schedule out-brief to Project Sponsor; develop slides and executive summary.
- Late Apr: Deliver out-brief to sponsor.
- Late Apr/Early May: Deliver full report to sponsor.

Challenges

The team will strive to conduct in-depth research and analysis to distill useful findings and fully answer the project questions above; however, some challenges may limit research options or analytical depth. Some of the anticipated potential challenges include:

- Classroom environment.
 - The team is executing the study in the context of a class at the U.S. Army War College. Students will be learning and applying concepts from the associated Futures Seminar elective course concurrent with research efforts for this project.
- Time Constraints.
 - Comprehensive historical research is time-intensive, and constraints may be based on a compressed timeline (NOV 2023-APR 2024).
 - Project work is conducted concurrent with Army War College core curriculum.
- Complexity of Historical Analysis.
 - <u>Limited Data</u>: Historical records may be incomplete, biased, or unavailable, especially for less-documented military organizations or technologies.
 - <u>Interpreting Historical Context</u>: Understanding the mindset, culture, and conditions of past military organizations requires careful interpretation, which may not always be straightforward (i.e. language).
- Information Overload.
 - <u>Volume of Data</u>: The sheer amount of available historical data can be overwhelming, making it challenging to identify and focus on the most relevant information.
 - <u>Technological Tools and Methodologies</u>: The project may require analytical tools for data analysis, which could be complex and require specialized knowledge.
- Limited information sources.
 - Due to time and other resource constraints, the team has access to mostly open-source information, and the final product will be unclassified.
- Limited Project Funding.
 - While there is money for travel and some other related expenses, it is not infinite. Travel may be limited due to a lack of available time and/or available funds.

Resources

A myriad of resources is available for the team to draw from for this project. A broad (initial, not all-encompassing) list includes:

- Personnel.
 - Professional experiences from each team member sum to several decades of Army and Marine Corps experience. Some useful insights that may apply to this project include:

- Combat/deployed experience in infantry, air defense, field artillery, and fires (planning and execution of integrating and de-conflicting multiple supporting arms)
- Physical security planning
- Space systems expertise
- Joint planning
- Team-building
- Recruiting and retention
- Institutional.
 - The U.S. Army War College Library provides a wealth of research resources, including proprietary databases.
 - The Army Heritage and Education Center (co-located with the War College) offers several resources to facilitate historical research.
 - Team members have access to subject matter experts (Professors and Historians) and will conduct interviews, as applicable.
- Money.
 - U.S. Army War College provides funding for the Futures Seminar and associated Futures projects.
- Other Resources.
 - The Futures Seminar introduces students to unique research, analytical, and visualization techniques and resources that will enable efficient team effort as well as product development and delivery.

Administration

- The final product will be provided in PDF format via unclassified email for the sole use of Lt. Gen. Anderson, Director, Joint Staff J-7, and those he so designates. This product will be delivered about the same time as the out-brief, or shortly thereafter (not later than the first week of May 2024).
- The team will coordinate with Lt. Gen. Anderson's Front Office in late March/early April to schedule an out-brief and provide read-ahead materials prior to the brief. The ideal timeframe for out-brief delivery is late April 2024.
- Team members include:
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Annex B

Transcript: Dr. Michael Neiberg (Speaker 3), Chair of War Studies, SSL January 2024

COL Simmons So what can we do to? Foster elasticity of law. And then final the final question. In the human dimension. Is probably akin to the future of work and the future of the military. What attributes and skill sets are going to be crucial, crucial for the US military in the next 10? To 15 years. So that that's their Tor, Sir. I'm sorry. And have you? Met.

LTC McCray I briefly walked down. I apologize, Sir. I got a I got a call.

COL Simmons MM.

LTC McCray Mike, I'm Mike as well. If it's all right, do we do we talk about a transcript for? We so we. This it is.

<u>COL Simmons</u> No problem. We we do want to kind of if if it's OK with you. Videotape is simpler. For our records.

<u>LTC McCray</u> We know what we sound like. We know what our questions are, but we're just very interested in what?

Dr. Neiberg You have to say, OK, good news and bad news for you up front. The good news is, I've been thinking about this and I think I have something to contribute that might be helpful, but bad news is I brought books that I'm going to. Leave with you guys that talk a little bit about this stuff, so. And I might have a couple of others.

<u>**COL Simmons</u>** So what we would like to, I think talk to you about Sir is so this. Is our TOR. Then I think the first question that. Professor Sam White wanted. Us to kind of go down the route with you and to help us, I think what like kind of kind of create this taxonomy of the? Question and how we approach it as a group of five in the futures question is the group's gotten together and we would like to ask the first question. How do you suggest "binning" the first part? Of. Innovation. As it relates to the military.</u>

Dr. Neiberg So I think one of the things I would urge you guys to be thinking about is that innovation is more than the availability of technology, right? It is how a a culture and a political system is thinking about the time period it is. It is existing in and what that technology. To before and the greatest one hand line I heard about this was a couple of weeks ago in London. Americans use social media and technology to open up to each other. The Chinese are using it to observe. Each other. So it it depends on what the regime in question really wants to do. I think one of the things is I was thinking about this over the last since you guys wrote me one of the big differences seems to me whether a country or a military is a status quo or revisionist country. So the question I've been asking myself and this came up in London when I was there about a month ago too, why did this Russian takeover of Crimea not spark more fear in Europe and the United States than it did? And that's not an easy question to answer. But I think part of it has to come from. The United States and to an even greater extent, the states of Western Europe wanting to hold on to the status quo so desperately that even something that was clearly an obvious shake up, did not force this process. Right. Maybe in the US, a little more than in Europe, but Germany, France, France to a lesser extent, Spain, Denmark, England, there were United Kingdom. There wasn't this kind of, Oh my God, we're back in 1938 again, which would probably would have been an overextension, but would be better than what what we did, which is to kind of say yeah, alright, he took it. What are we going to do about it? So I think thinking about the political context is really important. What is it that the state wants to do and that's going to drive, I think a lot of what's going on here. So the country that I know best in the Inter War period, France gets

criticized an awful lot. But if you're France from 1919 to 1939, there's really nothing you want. All of your state aims are in fact, negative. You're you're you're the classic status quo power. So given that what the French political system argued is it does not make sense to build 4 engine bombers. It doesn't make sense to build an offensive force that can drive deep into Germany because there's nothing over there that we want. We're a status quo country, So what do they do? They put their money into fixed defenses, which in that political context made a lot of sense. **COL Simmons** Yeah.

Dr. Neiberg Sorry. You have to stop me when I. Get rolling.

<u>COL Simmons</u> In I think what I was just. Because we often hear, like, Maginot Line was, this is probably my really uneducated. Uneducated opinions, but I thought the Maginot Line was a result of what we I thought. Was the French. General staff and the the the French military elite not being able to envision. A different style of war.

Dr. Neiberg I don't think that's it. I think what it is is the political the question that's asked in France in the 20s and 30s and by the way, it's asked in Germany in the 20s until Hitler comes in a different way that the the Nazis changed the way they asked the question. But the question is, if you're not envisioning a war, what is the military for? Absent of colonial deployment, right, which France has to do in Germany? Doesn't. The answer in France is the purpose of the military is to protect France. That's it. We're not invading anybody. We don't want anything. We're not going anywhere. So based on that discussion, the Maginot Line is designed, I think, to do 2 things. It is designed to be a force multiplier so that you need fewer people to protect the frontier than what you would have needed to do otherwise. And politically, what it's designed to do is send a message to Germany that we're putting our defense assets into something that cannot hurt you. And in the 20s, up until 1933/34, the Germans reciprocate, so German defense planning is designed to put in. Did they build this thing called the Siegfried Line, opposite the Maginot Line? They do the same. Thing. Right. It's the Nazis that say we're no longer a Germany's no longer a status quo nation. Now we're going to begin to radically change the technologies that we invest in.

<u>COL Simmons</u> Maginot Line and the Siegfried Line. And then the political establishment changes.

Dr. Neiberg In Germany it changes.

<u>COL Simmons</u> And that's why that's why we have the innovation. Of that, because we repurpose what we think the military is.

Dr. Neiberg Correct, because now what the Germans want their military to do. What the Nazis want their military to do is no longer status quo. Now they're envisioning a large revisionist military campaign, mostly in the east. By the way, France just has to be eliminated. So you don't do the 2 front. War. Thing again, right? I'm I'm simplifying greatly, but when the political context. Changes. What you want your military to do changes, and that will drive the kinds of technologies you purchase, etcetera, etcetera. So what I think you're seeing right now in Europe especially. As the Europeans are waking up to the reality that hard power matters, the question is what kinds of technologies do you actually want to invest in? If you're the British Army, which has like 1 deployable division, their argument is it doesn't really make sense to buy the stuff you would about 20 years. Right. You're going to need to buy something different. You're gonna have to innovate. Think differently. Unless you plan on building 10-15 more infantry divisions, which nobody in the British political system is envisioned.

COL Simmons Yeah. OK.

Dr. Neiberg Right. I think we're going to go through the exact same process, right, because what you've actually got right now are two different wars that Americans. Are paying attention. To and China as a as a side problem, you've got the Ukraine war, which is certainly not World War One, but. Definitely is showing this artillery infantry that stuff still matters. Armor still matters. Then you've got this crazy. You're transcribing this this crazy stuff going on in Gaza, which is something quite. Different. Yeah, right. So what do you guys resource for? It's not an easy question. Then you've got China, which is trying to skip an entire generation of technology. Altogether. OK, right. What? What, you're going to be conditioned by? Is in my opinion you take it for what you want. You're going to be conditioned as much by what Congress and the President and presidents to follow tell you they want you to do as you are by what you want to do. Right, right. If Congress says you're not allowed, you're not gonna buy XYZ, you're gonna buy ABC instead. That's what you're going. To. Do right and that problem is no different than what France and Germany that those militaries were dealing with in the 20s and 30s.

<u>COL Simmons</u> That goes back to your political and cultural environment.

Dr. Neiberg Yeah. Yeah. And it's also what your people will let you do, right? So in the 20s and 30s in France, until, I would say, until 1938, late 38, it's very difficult. To get the French people to think about anything other than status quo, right? Other than let's just pretend that it's 1925 and everything's OK. It's really late in the game that. Changes by that point it's too late.

<u>**COL Simmons</u>** Yeah. Who? No. Were you on? No, I think Sam White was kind of saying 1940s nineteen 40s when. Professor, I was saying that's. When the British had their awakening of the war.</u>

Dr. Neiberg I mean, I think they have it also in 38, I mean 38 is the moment when everybody kind of looks and says, OK, they really do want a war. They're not just blustering, and they're not just they really want a war. They they want to physically rewrite, redraw the boundaries of Europe.

<u>COL Simmons</u> By then, the power and difference. There's too much power and difference between what Germany has been able to accomplish and what the allies.

Dr. Neiberg Yep. I think it's also time, which is that the strategic resource, we don't talk enough about here at the Army War College. It's time right. By late 1938, the sands running out of that hourglass. And I don't mean to make this analogy too too tightly, but in 2014, Russia just takes Crimea like the sign, is there, right? They want to redraw the borders of Europe. Nobody in Europe wakes up. Nobody does anything and then they. Hey, Sam, you know? But so that by the time Russia invades Ukraine it it's this. It's a 1930s problem all over again. There isn't enough time to respond to it. Right, so to an historian, what went on between, say, 2014, when Russia took Crimea and when it did the full scale invasion of Ukraine? That to me looks a lot like the 1930s. You know what's coming? Your political, cultural, social systems can't make the adjustment fast. Right. And maybe your economic system can't make it fast enough because you're tied into purchasing legacy systems that you can't just throw away because they may or may not be relevant to the future. It's the same problem as. The 1930s. OK, so if it's the.

<u>**COL Simmons</u>** Same problem as the 1930s. I think that that's kind of like. And then to. What we wanted to ask for your expert opinion. How would you suggest "binning"? The different elements of this problem.</u>

Dr. Neiberg When you say "binning" it, you mean?

COL Simmons Well.

LTC Gueller There's five of us, right? So we have to take this problem set and and divide it in groups so we can kind of focus our collection.

<u>COL Simmons</u> Yeah. <u>Dr. Neiberg</u> Divide. It up, yeah. <u>COL Simmons</u> Culture.

Dr. Neiberg I mean, I think the big question for all of us is going to be what the American political system is willing to. Do. In the next 10 years, if, if, and I don't, when you get, I'm not getting partisan. I'm not advocating anything. But if the next administration comes in and says we don't feel the need to support Europe the way we once. Did. That's a demand signal to you guys. About what the political establishment wants you to do about these questions if the Middle East just does not let the United States withdraw from it, the. Way. We're trying to. I mean, if the Houthis keeps sinking ships or trying to sink ships. You're likely to be pulled back into the very place you least want to go back to. Right, that those are going to be contextual factors that are going to. And again, it's not unlike what France faced in the 30s, right, that there there were elements in France that said we need 4 engine bombers to deter the Germans. And the answer coming back was what? Where do you think you're getting? Like, we're not anticipating this. So I think one thing if I were you guys, I would try to figure out what the two. Rival candidates really are going to do. As much as you can predict, what are they saying? I guess Congress has sort of NATO proofed right? It's made it more difficult for a president to pull the United States out of NATO. So that's not in vision. But I will tell you every trip I make to Europe and talk to people, it is the question. I. Get once an hour. What's going to happen if Trump comes back in? Is he going to pull you out of NATO? It's the question I get once an hour. And my answer is I have no idea but my answer to them is the best insurance you can have is to spend you 2%. Spend it wisely. Then the demand signal from you guys goes down. Right. So that would be one thing I. Would want to look at if I were you. I think historically also it's culture and society matters an awful lot. Are you getting the signal from your people that you're not doing enough to protect us? Or are you getting a signal from your people? As I think they're getting in much of Western Europe? What do you mean you want to tax us to spend more on defense? Or you want to spend more on. Defense and. Less here. I'm frankly quite amazed at the American people haven't asked this question. Of you guys, all of us. Yeah, more than we have. Right. I mean this is an anecdote that I tell, but I think it's kind of telling I I was down at my dad's retirement village in Florida and this guy was just screaming at me that the DoD didn't have enough money. And I said if you can tell me how much the DoD has in the annual budget within \$100 billion, a \$100 million, I'll buy you dinner. Of course, he had no idea. All he knew was. Not enough, right? Right. So there's going to be a question about what the American people are willing to continue to do for wars that are frankly, other people's wars. And you're already starting to see that as there's been some pushback on both the left and the right about assistance to Ukraine and even Gaza. Israel, which has become a politicized issue. So I think that's going to be something if I were you, I would want to try to look at. Best as you can. And I mean. Question that should be keeping all of. You guys up? If you have resourced and built equipment for one warrant, you get the different type of war. How quickly can you adjust? Right. Is that great, Michael Howard? Statement that all of your plans are going to be wrong. The key is to be not so wrong that you can't adjust. Are we in that position or not? I don't know if this is quite answering you, but these are these are the questions they were trying to wrestle with in the 20s and 30s. Some countries did it better than others. I mean, I would argue none of them. Did it particularly well.

<u>COL Simmons</u> See your point? Because you kind of highlighted, so we've got. Ukraine Russia conflict, which is kind of traditional like World War One land battle and you have the Israeli. <u>Dr. Neiberg</u> Yeah, yeah. <u>COL Simmons</u> Gaza conflict, which is urban operations different. You know, you don't have maneuver space that you do on an open field.

Dr. Neiberg It's a very different thing, right? Very different thing, yeah. And quite frankly, I think the problem the Israelis are facing right now, it's a military problem, but it's also a. They're losing the public relations battle worldwide because they don't control the narrative in Gaza itself, right? And frankly, it's the same problem we faced in Iraq and Afghanistan, right? You you can commit an act, but you can't control the way that it's interpreted by people on the ground, right? And that's Israel's just lost that. And maybe they deserve to lose it. That's not the point. But they're not. They're not winning that my Israeli. Parents cannot figure out why Americans don't. 100% back them up on like 22,000 dead Palestinians is why right you you're you're not controlling the message that's getting to the American people. And again that's a problem that I don't think you're going to. Solve with technology. Right, my, my, my concern when I hear groups not just you guys, but when I hear groups talking about this is the desire to get to a quick technological fix if we just have enough of X and enough of Y we're good right. And the reality is that you guys know that's not. The answer? But technology is going to fit into a wider political, social, cultural system. It's also going to fit into a wider military system. If you've developed a military to do X, but then you're asking it to do Y, it may or may not adjust. This is the Vietnam problem. You take a Cold War full, the gap army, and you put it in the jungles of Southeast Asia. It's not custom built for purpose. And this is, I think another problem that France faced, thinking it would not have a war with Germany. It develops a war to go fight colonial things in Morocco and Syria and elsewhere. And then it has to very quickly turn and go back to to turns against Germany. And it's just not. The. Same it's not the same you're asking it to do something very different from what you resourced it for.

COL Simmons OK.

Dr. Neiberg And you guys would know far better than I would. What? This. What? What? The current army is resourced for.

COL Simmons Yeah. No. Yeah, yeah.

Dr. Neiberg But. But it may not be fit to purpose, right? And we haven't even talked with the the big word, which is China, right? I mean, if if you need this army to go to Taiwan, then that's a completely separate set of things that you need to do. And, you know, you guys know this. But if you turn it into a Swiss army knife, sooner or later. It's not. Going to have the tool you needed to have, right? Right.

<u>COL Simmons</u> So OK, so that's.

Dr. Neiberg Am I even coming close to answering your questions or am I just ripping? Please tell me if I'm not.

<u>**COL Simmons</u>** It's us well. No, no, we did have some help with Professor White. We we started with kind of like a DOTMILPFP approach and settled with like DOTMILP because there's. Five of us. And then. With with Professor White, we kind of updated that and kind of like looking at the doctrine, technology, weapons. I think we've. Really hit on the the next two. Which is almost like the domestic political environment.</u>

Dr. Neiberg Yeah.

<u>COL Simmons</u> We looked at leadership organizational. Culture. And then I just added society as well and I think it seemed like. The domestic political and society elements of the of the buckets. Help shape what's in the possible for the future envisionment and then the doctrine, tech weapons and leadership are a little more internally focused buckets about how the organization.

Uh. Well, I think what you're described as. How the organization navigates flexibility and so if we have a political.

Dr. Neiberg Yeah.

COL Simmons If we have a, if we have a political. Leadership in society that says we are comfortable with a large scale combat Operation Army, but we end up fighting. In Israeli Gaza urban environments, it's the doctrine, tech and weapons leadership and organizational culture of the of the organization itself that helps us navigate the flexibility necessary to change. **Dr. Neiberg** I think that's true, but I think the problem you may face could be even worse than that, that you could be asked to do something in a scenario against the Houthis or some you know, non state kind of. But they're not going to tell you that. Don't worry about China. Right. You're gonna have to walk and chew gum and juggle all at the same time. Yeah, right. Because the the number of threats that are out there and the variety of those threats are not going to go away. Right. So the other something else you said made me think of something. And forgive me, it's not directly related, but the the one of the reasons you're getting more pushback in Europe than you are in the United States when we face a problem with budgeting, we just. Borrow. The money most European states cannot do that. So when the French or the Danes or the whoever Italians go to their people. And say we want more on defense. The question has to become what do? You. Take away. Is that going to be health services in the wake of COVID? The answer is no, right? Is that going to be public transportation? Is that going to be, I mean, name your thing right. In Denmark they actually tried to get rid of a Holiday. Right to to get people to work on a holiday, thinking that might be enough money to get you where you want to go. There was a a recent reform in France about retirement ages. Yeah, that caused all those protests. My French friends told me behind the scenes the reason they wanted to do it was to have enough money to put back into the defense budget. But they didn't want to. Say. That right, you're going to work three more years so the army can have another tank. Was not what they thought was going to be a winning. But they can't. France cannot constitutionally just borrow money like the United States does. Right. So part of the reason you're getting the pushback in Europe and you're not getting in the US is we're not asking our. People to. Make trade-offs right? If if a political candidate comes along and says hey. If you want X, we have to do away with Y and is serious about pushing that. You're going to be in a different ballpark. Right? Right now, we're comfortable printing the money or borrowing it or whatever. We're doing it, borrowing it from our grandchildren or whatever it is that we're doing. Right. If a moment comes when that stops. Then you're facing real discussions.

LtCol Raisch For the aspect we discussed yesterday. And and you would know. Better, I think, than I would about. The inner wars. One of the. Biggest things going on now in the US. Globally was just an economic crisis that occurred in the 20s or 30s, correct? And that? **Dr. Neiberg** Yeah.

LtCol Raisch I don't know if. It forced certain. Types of innovation to do, kind of. Do more or less, how do we? Find other ways around getting this done. Or if it hindered. It in some other aspects but.

Dr. Neiberg What it what it did, I think is vastly complicate a set of problems that already existed. So a you have less money B you have more demands on the money that you have and C you have all of these knock on problems that are happening along the world. And one of the ones that I've got I'm working on right now. In. My own research is just refugee flows that occur in Europe because of the economy. Of depression and there's people. Millions of people moving left and right all over the place and Europe can't control it. And like today, it's radicalizing political

systems. And it's just making it difficult for people to make decisions, political decisions radicalizes Germany. But it also Radicalizes France and Radicalizes Poland and radical, you know, it it just, it just takes the problems you are facing.

<u>LtCol Raisch</u> And radicalized Germany.

Dr. Neiberg And just accelerates them. So we don't think of the crisis on the American border with Mexico in that way, but it could get that way where it's starting to force decisions about. I mean it. People are openly talking about it, you know, throwing away the posse comitatus laws and putting active duty U.S. military on the border. That's that's that would be a change, right? And the demand signal to you guys that my guess is most of you would like not to. Have to deal with. Right. The Great Depression is incredibly important, but for more things than just money starts to run out, right? You you rethink what you want the army to do. So the Civilian Conservation Corps becomes an army project, right? You start, you start to reenvision how the military can help you deal with not just the obvious crisis, but. The the the crises that spin off from. Right when you have 25, 28, thirty percent unemployment. The government is a sponge that can help absorb some of that. That's what Greece does, right? The Greeks will tell you they're they're way over 2% of their of their budget towards defense. When you look at the numbers, it's all salary and pensions to people that they're trying to employ, right. So it's not helpful, right in in a, in a NATO sense, right. It it's not actually very.

COL Simmons That's yeah.

Dr. Neiberg Awful, right? I don't know if that quite answers your question, but you want to think about when you think about economics, you want to think about more than how much money is being given to defense departments. You want to think too about the way that this is changing. Prioritization decisions. So what happens in France? I think you're right. The French Government increasingly says, look, we've got an economic crisis on our hands, money we don't spend on defense can go somewhere else. This is what the United States. Did too. Then you have this moment where you just wake up and say, OK, that was a bad idea and now money has to. Be thrown at the problem. But that's a different. Yeah, I mean the other thing, the Great Depression did, which was actually good for the United States, is it meant that when 1941 happened, we had all this excess industrial capability that wasn't being used. We don't have that right now. Right. That were empty factories that were people looking for work. I mean, it was easy. Right. That's why the that's why World War 2 is the, quote, UN quote, good war, right? It's really easy. You've got unemployed people here and you've got empty factories here. Bang. Right. You can take African Americans who had been whose unemployment rates are far higher than whites are. And you can put them in. I mean, you can bring in Mexican farm workers.

COL Simmons Nationalize it.

Dr. Neiberg I mean, there are these. Kind of Labor pools just sort of sitting around. It's a lot harder to do that in the late 30s or early 40s. Sorry today than it was in. The late 30s and 40s. **COL Simmons** Yeah, yeah.

Dr. Neiberg Sorry miss.

Professor White And like how much I'm sorry, but how much of all of this of the difference during the inner war was? Was shaped by. His words but but. The the offensive mindset created by inevitability. You know the the Allied powers are like, oh, this can't happen. Oh, this is terrible. The Axis powers. This is happening.

Dr. Neiberg So I think part of it when you think about France and Britain, you have to remember this is another thing. I think it's important to think about, we think about World War 2 as the inevitable conflict, right? The one the, the war. The French are most worried about. Is the

civil war in Spain? Why? Because it's right on their border. Right. And and things that are happening in Spain are bleeding over into France. So if you asked a Frenchman in 1936, where is the inevitable war coming, that would have said, Spain, if you'd asked a Brit in 1913, where is the inevitable war coming? They would have said Ireland. Right, because that's what they're focused on. I think the problem you guys are they got it wrong, so that that's a problem. But the issue you guys are facing we are facing is that we have multiple. There are multiple crises and in 25 years I could see an historian writing and saying conflict with China was inevitable. Conflict with North Korea, conflict with Iran, right? I mean, you can go down the down the list. So inevitability, I think. Is less the question in my mind than the prioritization of the political establishment. What is the crisis they're worried about? So, remarkably enough, if in 1938 you would have said to the French political establishment, who will you be at war with in two years? I think Spain and Italy would have been one. And. Two and Morocco might even have been three. Germany might have been 4th down the list. And they were wrong.

Professor White Right. And but if you ask Germany, if you ask Germany in 1930.

Dr. Neiberg Poland, Russia Czech for Czech, Slovakia. France maybe? Right. I mean. This is true in 1914 as well, like the the the thing that brings everybody to war in 1914 is actually not something between France and Germany. It's actually something happens in the Balkans and sucks them in, right? Right. So that's another problem, but separate separate problem. How do I want to put this? We think of World War 2 and World War One as Western Front wars. To the Germans, they're Eastern wars.

LtCol Raisch OK.

Dr. Neiberg Right. What? What, what? Germany is what? Germany and Russia are fighting over is what we today call Belarus, Poland, Ukraine, France and Britain to a certain extent, get pulled into those conflicts as proxies because they're proxies to something else. But the two world I mean, I would argue if Europe goes to war again, it's going to be in the it's gonna be in the same part of the world, right. It's going to be. Over Poland, Ukraine, Belarus. That that's what it is. I think it's fundamentally about Russia's inability to live in the House that they have. But that's another matter.

<u>Professor White</u> But since that is but since. Back then, in both world wars and now, the alliance system is what it is, and so you can sort of anticipate if this then that.

Dr. Neiberg Yep. Yeah.

Professor White Sort of say because you know, like in China, China has said in no uncertain terms it's inevitable we are reuniting with Taiwan, right, you know, unambiguously, should we? **Dr. Neiberg** Yeah. Yep, yeah.

Professor White You know and.

Dr. Neiberg Yeah. How seriously should you take that?

Professor White And should we have that same? Should we have that same mindset then that it's inevitable if we're going to, if we're going to secure?

Dr. Neiberg Yep. There. Yeah. And and to what extent are I mean up to what point are you willing to do that? Right. So the response from the United States could be you know we're we're willing to make a rhetorical.

Professor White Security guarantees all have business.

Dr. Neiberg Statement put a carrier group in there, but we're not gonna send American. We're not gonna put Americans in Taiwan, right? I mean, the Israelis have told me we don't want. American soldiers. Over here? Yeah. We don't want that. Like, we'll we'll do like a carrier group and the Med. Thank you. American soldiers on the ground. No. Yeah, right.

Professor White Is it different that sense of China? US now. Is it different than the thought of Japan, US?

Dr. Neiberg So I don't think you'd come into the room yet, Sam, but one of the things I said was I think it's a tremendous difference in thinking about whether. A state. Is status quo or revisionist? Are you OK with the world the way that it fundamentally is? Or is there some nagging thing that has to get changed like my I was in Israel in August. I was as close to the Gaza Wall as I am to that wall. And I had this conversation with the Israeli 2 star who was showing us around down there. And I said to him, I don't mean to make myself sound clairvoyant. I'm I I certainly did not predict anything. Came but I said to him. You Israelis can live with the status quo. You've got a wall there that you think gives you security. Hamas is on the other side of that wall with nothing to do 24 hours a day, seven days a week, 365 days a year, then envision how to breakthrough that wall. That's it. That's their only problem, right? They don't have to do what they did in October. They just have to prove to the Israelis at the wall doesn't give them security. That's it. And his answer to me was, oh, the walls great. Don't worry about it. There's sensors underground, there's sensors above. It's fine. That status quo complacency. Right, Hamas doesn't have it. I would make the same exact argument with Russia, right? Everybody in this room knows perfectly well anybody who's ever been to Brussels knows perfectly well NATO is not built resource designed to attack Russia. It just isn't. Right. It just isn't. We all know that, right? But Russia's argument is. We have to change the boundaries of Europe because NATO was a threat to us. Right. Unless you live in Poland or Estonia before the invasion. You can live with the status quo perfectly easily. I think that's the difference. When I go to France, the French can live with the status quo. When I go to Poland, the Poles are terrified at the stairs, the status quo.

<u>COL Simmons</u> Getting back to. What I wanted? To ask you is. What you said earlier, like about France in. Three of one of the readings we were talking. One of the readings. I read discussed the Spanish civil war. It discussed actually how Germany took advantage of Spanish Civil war to do like. I think it was like first.

Dr. Neiberg Yeah.

Professor White Airborne operation.

Dr. Neiberg Yeah, they did. Airborne over Guernica and yeah.

<u>COL Simmons</u> Artillery, mechanized artillery and close air support, and so to bring that up is if France so.

Dr. Neiberg Yep.

COL Simmons Two-part question, the first one how important. Is it to? Observe or have military leaders in active combat to experience it versus versus just kind of waiting for the lessons learned to be fed.

Dr. Neiberg So let me answer that one. So I think that's a little bit overstated what I think was important in the 30s. Germany has a fascist government. It's trying to support in Spain. What you have is a Republic is voted in a left-leaning socialist communist government has voted in in 1939. An army-led kind of fascist so people argue about whether the term is appropriate or not. Army group. Rebels against that government and tries to take it over. So which you have in Spain? Very closely matches the political system in France, which is run by a leftist government called the the Popular Front, which is opposed by a right wing group with a lot of sympathizers inside the army. So the reason why this is important for France and it's not important for Germany is not because or not critical to Germany. It's not because the Germans have military advisors in the French don't. It's because the war in Spain, if it trickles over into France, is going

to trigger the same kind of war in France. It's not going to do that in Germany because the Nazis have already arrested everybody or killed everybody or put them in camps, right? I'm overstating the point, but you, you get my point. So to the Germans, they can. They can give resources to Franco's phalanges. They can bomb Guernica. They can do whatever else. If it doesn't work, it doesn't. If France or Britain gets involved, Britain, for different reasons. If France gets involved and it doesn't go well. The backlash could be civil war in France. Right. So the reason this is the the Spanish Civil War is important. Is because it makes France much more cautious about foreign interventions of all kind. Right in my worst nightmare scenarios. The 30s look a lot like the United States, a very, very badly divided polity inside the United States that is looking to over exaggerate any difference with its fellow Americans. On the other side of. The political spectrum. That could mean, as I think it is meaning now, though not the violent way that it was in Spain. That Ukraine and Gaza become domestic political issues before they're understood as national security issues. Right. So what you have right now? I have left-leaning Jewish friends. Who are so angry at the Biden administration that they're contemplating voting for Trump and I have right leaning Jewish friends who are so angry at the at at the the Republicans over Ukraine that they're considering switching over to the Democrats. That's a weird mixing of political allegiances, and it has nothing to do with national security. Right. That's what you see in France in the 30s, something very, very. Similar to that.

<u>COL Simmons</u> So if I take your point did.

Dr. Neiberg That make sense?

COL Simmons I think so with. Like for, for me? Troublingly, what I think I heard was Germany saw an advantage because it didn't cloud its activities in the Spanish. Civil war through a political lens. They saw the Spanish Civil War as an opportunity to practice. Military. **Dr. Neiberg** Checking. That may be what the army and Air Force saw, what the political leadership saw was an opportunity to use military force to help Franco. And it worked. Yeah, to help Franco defeat a Republican democratic government so they could make the point that democracy was outdated. This new fascist thing is the future, right?

COL Simmons That was that was the. Political environment and and after product of that was Germany, Germany got to practice in in the Spanish Civil War. And what I think I heard was because France. Felt an existential threat if they got involved in the Spanish Civil War, they missed an opportunity to observe military conflict and post World War One kind of technology. **Dr. Neiberg** They saw it as too risky, but I think the French answer would be we can see that in other places the world's not peaceful. In the 1930s. There are other places we can observe this. Happening and I guess.

COL Simmons The the question was why didn't? The observations from the Spanish Civil War get inculcated into the French military that may have caused them to say is the Maginot Line. What we need to do, or we're we're seeing different things, and therefore we need to adapt so. **Dr. Neiberg** The key for the French, I think, and the Germans believe this too. A civil war is a hard one to model, right? I mean, if you read George Orwell wrote the best. George Orwell fought on the on the Republican government side and wrote, I think, the single best book about war that I've ever read. He he was in Barcelona, right. And if you read that book or you interviewed? George Orwell. There's nothing in that that's going to help the French deal with their problem with. Right, this, this, this, this is the the, the, the world that Orwell writes about in Barcelona is like 6 different political groups all shooting at each other with no political authority going back to anybody, right? If I were French and looking at that, I would say that's less important to me. Then. Uhm. What the Poles and Russians are planning to do to each other if war

breaks out again, like how they're thinking about deterrence, how they're thinking about, you know, that's not to say nobody in France was looking at what was going on in Spain. But I think it would be like, like, like Milka, like Molka did not look at the American Civil War as a model for what he wanted to do. He looked at it as a bunch of people badly. Trained and badly understood picking up guns and shooting at each other because they were really ***** *** at each other when what milk is trying to do is a series of small, sharp, unemotional wars to get to this strategic and state that he wants the American Civil wars simply. Not a model. For that. So I guess maybe another way to phrase that is not all wars are seen as modern. OK, right. Some like Gaza's going. Backwards. Yeah, right. There's certainly things for you guys to learn about Gaza, but to me, Ukraine, Russia, is that if you're gonna pick one conflict to look at. That's that's what you. Guys are likely to get involved in, right?

<u>COL Simmons</u> A large scale combat operation.

Dr. Neiberg But between 2 between 2 entities that actually report to political. Right there is some kind of chain of command. There is some, I mean all the deterrent stuff that we teach, right it it it should. It should at least apply intellectually. OK to Russia, Ukraine. It doesn't. It doesn't work at all in Gaza. It just doesn't. Right when I talk to the Israelis about it, they were like, well, what the hell does that do for us? Like in their mind, they're in this constant perpetual war that never ends, and you can't make. An. End right. That's that. I don't know. I don't know. To do with that, that's not what we teach, right? We teach you, use military force to achieve a political end state. Right. The Israelis aren't even talking political end state, and Hamas's political end state is all the Jews get killed? That there's no room for strategy in that. That's why you're seeing what you're seeing. OK. Right. There is no room for strategy there, right. Negotiation. Yeah. There's something to negotiate over. Right. Same thing happens in Spain. Right. There is nothing to negotiate.

<u>COL Simmons</u> Over so that right? Yeah. OK. I think the better explain because I think for me it was. Interesting the the for you. What author? There was an author was saying like hey, the Civil War. Spanish Civil War was a great testing ground of military capability.

Dr. Neiberg I'm not sure. I mean, I'd have to look at the documents and have to look at what the Germans were actually saying. Yeah, but I mean. So the Germans learned that you could. Bomb a city. Did they learn that there was some political end state you could get out of doing that? I don't know, like what they got was Picasso, right? What they got was Picasso painting Guernica and turning the world against the Germans. Right, that's what they got, right? So. I don't know. Again, this is I. I hope what we teach here. There is a great difference between what you can do and what you should do. What you can do is technological right. What you should do is strategic and intellectual. I hope I'm making sense.

<u>**COL Simmons</u>** Yeah. So actually what? I just think I what I was. Just thinking about that was. Between what we can do and. What we should do? What drives military innovation is partly, and do what innovative acts. Get us closer to achieving the political.</u>

Dr. Neiberg Ends correct and one of the problems we face in the United States right now is we don't know what that political end state looks like. We don't have a grand strategy, right as far as I know, there's no George Kennan saying what we're going to do is fight this long, drawn out Cold War with the Russians with as few military casualties as possible. We're going to outspend them. We're going to show them that we're morally better. We're going to prove to them that democracy is better. And it will collapse from within.

<u>**COL Simmons</u>** It almost sounds like. Military innovation is best driven. By the the, the, the the speediest way to. Achieve your military your political ends.</u>

Dr. Neiberg When you know what that end state is, right. Right now, it feels to me like we're just plugging holes everywhere we go. Right? The Houthi starts sinking ships. OK, we got to go do something. About those guys.

<u>LtCol Raisch</u> That ties to a status quo.

Dr. Neiberg It absolutely does. I think for most Americans, I think that's that's correct. I don't think we do. I don't think we do and there's no reason why we should, right? We're still the number one economy in the world, no matter what the Chinese are are trying to do our, the dollar is still the reserve currency. This is still the place of innovation. This is still the place of democracy. This is, you know, problems with any individual. This is still the.

<u>LtCol Raisch</u> We don't want anything to change.

Dr. Neiberg Place. Why would we want to change? And we've got little problems. We got to deal with around. The. The edges, but we don't want to. Burn the house down.

LtCol Raisch But that, like you said, right, breeds complacency. So if we're complacent. We're lacking grand strategy because we don't correct do what, correct?

Dr. Neiberg Correct that the strategy is to keep things exactly the way that they are. Right. Can we do that for much longer? I don't know. You know, in in Europe the situation is. Well, it depends on whether in the West or the east. If you go West of the Polish German border, it's very much the same thing that we're on a good glide path we. Can keep doing this right? Or what it would cost to change. It is too high. So. I mean, again, I'm oversimplifying. If you're Greek, I mean, we were just in Athens in October. I mean, they still talk about the loss of Constantinople. That was 1453, right? The problem is, Ukraine guys, you know, and I think and, you know, they get it, but there's a certain level of complacency there too. Right. Ukraine is very, very far away. How much can you ask your people to sacrifice for if you're in Poland or Estonia or Finland? That question is very, very different.

<u>**COL Simmons</u>** We talked about military innovation. And achieving a political end, it almost seems like we also need to focus on is. What in British, French, German, Russian and American militaries. What was? What enabled that flexibility? Well, you know what organizations were flexible enough or?</u>

LtCol Raisch We're.

Dr. Neiberg Where your organization was the one I think you could argue was the most flexible. The Marine Corps. Yeah, in part because they were threatened to be legislated out of. Existence. **LtCol Raisch** That's where the resource constraints I think that economic factors in. **Dr. Neiberg** Correct.

LtCol Raisch That the grand scheme of things. When it whittled down to what? The What the military was doing was looking for ways.

Dr. Neiberg Correct. To cut correct and one way to do it is just say we don't need a Marine Corps, so the Marine Corps was faced. With the challenge of saying yes, you do and here's why. **LtCol Raisch** And [inaudible] was born from that and amphibious doctrine was born from that. **Dr. Neiberg** Correct. Let's have some right. That's absolutely right. No, that's absolutely right. What I think you had in France, I mean again the Maginot Line, you can read the Maginot Line as a bunch of stupid people who didn't, who couldn't predict what was coming in 10 years. Nobody can predict what's coming. Ten years or you can read it as as I would. It's a military response to a demand signal from the French people. We already fought a World War. We lost 1.2 million people and no one really knows why. No one can really explain it. What we want you to do is keep us safe so we don't have to think about this anymore. From that, the Maginot Line is the most logical. Thing in the world. Right. It's the most logical use of military assets in. The.

World right the way they used it in 1940 was problematic. But. I think you're already done by that point anyway, but the question I hear my British colleagues asking the British Army is facing the same the British Army. If it goes to the British cabinet and says we need more money to build another division or do "X", the answer is what for? Where do you think? You're. Going one British division is not going to Ukraine. Right. One British division is not going back to India to conquer it. What is this extra division you want for now? If you say we need a brigade to do enhanced forward presence in the Baltics, OK? But you want another division, the question is. What's the political signal? What is it that you want to do with it? And I think the British Army doesn't have an answer. So the money goes to the Navy and doesn't have a convincing answer. Yeah. So the money goes. To the Navy and it goes to the Air Force. France, which is on the continent. France, which knows that Germany's next door and is unlikely to do anything productive. France has a different political discussion to have. So I think a large part of this is not simply technology, it's the political context and social. Context. Maybe it's the difference between going to the store and knowing I need a computer that can do these things, or somebody handing you a brand new computer and saying figure out what you can do with this right? We just built this TV studio downstairs, Kevin Dickson, our associate comment on shows me everything you can do and he tells me figure out how we can use this. I don't know. I'm historian, I'll try, but I I don't know right?

<u>LtCol Raisch</u> Problems for solutions we see other way around.

Dr. Neiberg Right, which is what Mark Zuckerberg did, right. Like, who knew you were gonna want to take selfies and put them? And. Who knew I was gonna want to take pictures in Italy and put them on Facebook? So my mother and my older mother. Can. See what her grandchildren are doing. Sometimes technology appears, and then you realize, Oh yeah, I didn need that. My fear is, as Americans, we tend to think, give me the right technology and the other problems will solve themselves. And that's not going to work. Right, you need to figure out what it is you're trying to do first, and then figure out how to develop unless you come up with something that just shows up and you say oh. I didn't know I needed that.

<u>COL Simmons</u> So it almost sounds like. I'm just going to speak plainly. What we what? I heard what I heard from General Anderson was 2 examples. One was German blitzkrieg and the second was Dowding, Dowding.

Dr. Neiberg Yeah. The British air marshal.

<u>COL Simmons</u> Integrated artifacts. And the reason? Just always bring that up is it seems like those examples in our decision makers mind or examples of military innovations that completely changed the framework of the battlefield and maybe that's.

Dr. Neiberg Can I put a gigantic asterisk on your first one?

COL Simmons What I think I'm hearing from you. Sir or Mike is. Those are those are really minor things that not minor things, but those. Are the things that lead to innovation and those aren't the things that lead militaries to maintain a status quo or be as successful revisionist. Those are just things that. Happen off the on the.

Dr. Neiberg Well, I think it's more than that, but I mean, So what the Germans did in the 30s, their signal was build this, the military that can win.

COL Simmons Things. Yeah. OK.

Dr. Neiberg Within resource constraints and those resource constraints were not that many fossil fuels, and an inability to do logistics over long distances. So the Germans built quote UN quote blitzkrieg, even though that phrase, they don't use it. The British use it. The Germans never use that word, they build something that can defeat Poland. If the Russians take the other half,

remember that if the Russians. The other half you can beat Belgium, you can beat Denmark and you might have a chance at France. It is not built for what the Germans actually use it for which? Is to invade. Russia. Yeah. Right. When they do that, it it, it disappears, it evaporates it, it gets crushed because you build something. So one demand signal and now you're giving it in a completely different demand signal. And this is victory disease and all that other stuff we're. So again, I would be careful. Because the British are, as the Germans are, as surprised as anybody else that they beat France, they're as shocked as anybody else that they don't think it's going to work. And there are historians who argue that a couple of things switch a different way. It probably doesn't work, at least not in the way that it does. I guess there I'm a clausewitzian, right? I mean, a lot of this comes down to just. Dumb. Luck. I mean, you guys may know this, but a plane crashes with the German attack plans for 1940. In it, they don't know what those plans are. They're afraid the French have them, so they make the adjustment and Manchin comes up with that sickle cut idea. Right. You could make an argument if that plane doesn't crash, the Germans do something. Very uncreative, and the French defense plan is perfect for it. **COL Simmons** They don't go through Belgium, right, that's.

Dr. Neiberg Right. They they go. They go like this way instead of. This way. Yeah, right. You you could make the argument that if that plane doesn't crash, the French can probably hold out for much longer than they did. Right, Dowding I think is a better example right of a guy who was able to clearly diagnose what the problem was. But the difference there is he's given a relatively. Limited he's not told to go beat the Germans. He's not told to go invade Germany. He's told to develop a technological system. That can solve an immediate problem. So.

<u>COL Simmons</u> A good example for. A to address a very limited scope problem.

Dr. Neiberg Yeah. Yeah. Which, by the way, I mean. You guys are really, really good at the United States Army and Marine Corps. You guys are really good at this. Give me a give me a narrow problem that I need to solve. You guys are outstanding at it. It is not your remit to figure out a grand strategy for dealing with Ukraine. But if you're told, go send a couple of brigade combat teams to place X and solve Y problem. You guys are really good at that. It's matching it to the overall strategic. Plan that gets really difficult, especially when the politicians don't give you a particularly clear one. Right. Go to Afghanistan and do XY and Z for me. You guys are good at that. Figure out a way to make Afghanistan a democracy, that we can leave on its own. Is asking you to do something you're not.

LtCol Raisch Capable of doing the weakness is potentially a lack of grand strategy and and flexible state current or.

Dr. Neiberg Yeah, I think so. I mean, and this is difficult, the more polarized our political system gets, right. So my father, who has turned into a Trump Republican, he wasn't. He wasn't that way when he was raising me. But he is 1 now, reads every International Security crisis through that prism. And I can't stop him, right. I can't get him to say, take the politics out of it. What's in American interest? He can't think that way anymore that did. That was not the case in the cold. Right there was there was difference at the margins, but there was an understanding. What is it? Partisanship stops at the shoreline or whatever we said in the Cold War. That's out the window. Right.

<u>**COL Simmons</u>** 9th and half. What were other good examples of? That come to your mind as far as. Very limited in scope solutions.</u>

Dr. Neiberg So I think again, I don't want to give fascists too much credit, but the Italians, the Italian decision to invest in an Air Force, right, the the fascists were fascinated by aviation. For reasons I can talk about, if you want me to. But they were fascinated by aviation, the. Italian

fascists. They recognized the difficulty they were going to have of moving ground forces over long distances because of the geography of Italy. So they built a very powerful Air Force. The problem was, as you guys know, air forces can't hold ground, right? So if you want to go to Albania or Greece, the army has to go anyway. And they asked their army to do something. It was never resourced to do. I think that's a pretty good example. I think the US Marine Corps with the Fleet marine force and amphibious stuff in the 30s is a very good one. Again, knowing that the Navy was going to do a lot of the logistics and heavy lifting and moving and all that kind of stuff so they could focus on one small. Problem my friend Brian Lynn has made the argument that the coastal defense force in the United States did a really great job. The counter to that is it was never tested, right? I mean, nobody ever showed up at Raleigh, NC and tried to move inland. Brian's argument is they they would, right. It's really, really difficult to do. Uh. I think those are all examples of things that did work pretty well and in part they work pretty well because they are connected to a grand strategy, right? I mean, we forget about it because they never had to worry about. But Brian's point is that's what the United States resource in the 1920s was coastal. COL Simmons Defense that Russia during the interwar period. Developments in "deep war". If that was successful, because what we talked earlier is like, you know, Germany impaled itself on Russia.

Dr. Neiberg Yeah. I mean, I think it's a fair question, an offensive strategy that gets 12 million or whatever of your guys killed, how successful the strategy is that right, I mean, the Russians seem not to care how high those numbers go. They don't care. Now when they didn't care then, right. It's not a strategy. Than any American could have designed and had accepted. It is one that the Russians can do. Right, right. So again, it has to, it has to. Nest within what?

COL Simmons Their political and. **Dr. Neiberg** Society. Yeah. One of the reasons

Dr. Neiberg Society. Yeah. One of the reasons we're so obsessed with technology in the United States is we don't want to, and probably cannot build a 12 million person army again. So technology is gonna have to substitute. Right. The Russians. You know, I mean, the thing I read just this morning, they are investing quite heavily in modern technologies, but they were content to go into Ukraine with a 1995 army. Right, they were perfectly happy to do that. Right. So again, it has to fit within what it is you're trying to accomplish. Yeah. I mean, you could argue what Finland did. Fit pretty well like they knew they probably couldn't stop a Russian invasion, but what they could do was make it awfully painful. And they did. You know, the polls had some really interesting ideas until it became obvious to them that the Russians and Germans were actually going to work together. Then you've got no hope of anything, right? Right. There's nothing you can do. But they had some really interesting ideas about how they might fight one of those two and do it successfully. Right plans, by the way, they're dusting. Off, yeah. Now that they don't have to worry about Germany coming from the other side.

LtCol Raisch You talked about like flexibility and. Getting it close enough to. Not be so wrong that we're.

Dr. Neiberg Yeah, that you can't adjust.

LtCol Raisch But I think there's. How much you can adjust? Also part of that equation. Yeah, just work. Where you not where you plant the pin, but. You know how big of a circle you're. Able to go around that area.

Dr. Neiberg I think that's right.

LtCol Raisch And in that, you know. You've got people and you've got things and you've. Got processes, yeah. UM. And so we look at. People in terms of. Recruiting, recruiting the right kind of people. And then how do we educate and train those people as we as we retain them you also
have? Procedures and doctrine, but probably even more so different layers of bureaucracy that. They tend to protect. It the bureaucracy to protect themselves.

Dr. Neiberg Yeah.

LtCol Raisch Sometimes to the detriment of national interests, yes.

Dr. Neiberg Yeah.

LtCol Raisch And then of course you got the. The technology. But just just on the people. Processes organizations from an inner war standpoint. What sort of fostered that sort of flexibility? What fostered how big that circle was?

Dr. Neiberg And that's a fascinating question. Yeah.

LtCol Raisch Well, what didn't? Where did it fail?

Dr. Neiberg That's a fascinating question. So part of this is, you know, the prestige of of joining the military in in a given point. So in Inter war years in France, it's difficult to find people that that want to serve and want to stay and want to go through that process. In Britain, I would argue it's probably more prestigious to go out to India. Than it is to join the join. The Indian Civil Service than it is to join the British Army so. How you know where do those ideas and where do those thought processes come from? That's a great question. To think more. About that. Obviously it comes from some folks like Dowding who are. Look, I'm going to put my bias on. The. Table here, right? It's not just that you train people in the right way. So you educate them in the right way. Yeah, right. They have to have a broad enough brain to be able to understand what's happening and to adjust. So the guy that I think of the most is Lord Allenbrook, who's the. British equivalent of George Marshall. Who is doing a lot of this on the British side and a lot of, you know, one of the reasons Alan Brooke is so well known is because he left behind not only his diary, which is published, and you guys should read parts of it. But he also left behind his entire library to the Liddell Hart Center in London. And most of those books have nothing to do with the military, right. He's training. His brain to think about technology, to think about medicine, to think about culture. I mean, there's a I think there's more books about birds in that collection than anything else because he had the he wanted to understand. How is it that large groups of things communicate and how do they, you know, This is why I.

LtCol Raisch Broaden. Thoughts on things?

Dr. Neiberg Yeah, This is why I foot stopped so much about history here and to anybody that will listen. And I'm grateful that you all are willing to listen because I think history is the single best tool for this. To broaden to open up your intellectual aperture and understand that. You're not the first people to deal with this, and that there are answers and solutions out there, or at least insights out there. They're just waiting for you to discover them. The whole human experience is waiting. For you to discover them. So much as I understand why bureaucratically, they want you to learn how to do TTPs and all the other acronym things here. If I were king of the world, I mean, you guys would read George Orwell's experience in Barcelona and you, you know, that's why we do through cities like all this stuff. Has been done before.

LtCol Raisch One experience back in the previous school a. Long time ago, wrote a paper that. Are you into the fact that officers should be? Required to. Study some sort of art.

Dr. Neiberg Yeah, promote that person immediately. And and you guys in the Marine Corps do this better than most services do, right? Because you guys don't care what you major in as an undergraduate, right? Every other service pretty much does the Marines sign? It doesn't matter. We'll teach how to be a marine. We know how to do that. Major in philosophy, major in art history, major in, you know, whatever. Like I did this thing. I don't think we'll ever use it here.

But I did this thing that big wall that doesn't. Work. The video thing that doesn't work, I did a thing on Picasso's Guernica like. I mean, it's it's an unbelievably important public statement. **Professor White** I'm sorry.

Dr. Neiberg The Picasso's painting Guernica, you know which is now in Madrid, but used to be in New York City for a long time, like it has a fascinating history of its own. Like, again, the Germans get the military effect they want by destroying Garrigan, which is a a Basque market town. Picasso flips that by saying, look, that this is this is mass murder. That's all this is. Right, that this is the battle Israel is losing right now. OK, right. Israeli, the Israelis. My Israeli friends will come to me and say. How does the world not understand that we're killing Hamas? My answer is you've lost. You lost that thing a long time ago. You lost that battle. 15,000 killed ago. Right. That's why Dowding can be so successful, right? He's not. And that's why Dowding is a great hero. And Arthur Harrison in in London is not Dowding Head Fighter Command and control of defending England. Harris's job was to kill Germans. Right. Downing gets to be Sir Q Dowding, Harris never does end up on the honors list. Right. He gets his statue in in on the Strand. Someone throws red paint on it. Even today, like once a year, once every two years. Someone. Comes by throws red paint on it. Why he's killing civilians, Dowding's protecting. **COL Simmons** It goes back to the point earlier like. Narrative or political goals like like. **Dr. Neiberg** Yeah, yeah.

<u>COL Simmons</u> Military, the military innovation that achieves a political goal is value versus what you can do, which is indescribable.

Dr. Neiberg Brute force versus, you know, an application of of. That's why Curtis LeMay has, umm, that he ran with George Wallace as vice president. But I mean, that's why Curtis LeMay has nothing really named after him either.

<u>**COL Simmons</u>** I did have a question. So when you talk about flexibility. Our group was kind of talking about 1 interviewing other one. One of the questions we want to ask you later on is like who else should we talk to too? Is it worthwhile to kind of examine army, air and Navy War College or and Marine War College curriculum to to ask the question. How does this curriculum foster a flexibility of mind?</u>

Dr. Neiberg Yeah, I think that would be worth doing. I think the answer might be. Because training does not foster flexibility of mind, education does. Right now we're we're we're better than most of PME, right that this we we at least when we talk to ourselves we say this is a place that is about education.

COL Simmons Yeah.

Dr. Neiberg Right.

LtCol Raisch The Marine Corps definitely makes a distinction.

Dr. Neiberg Yeah, and Fort Leavenworth will make a distinction, too, if we're more on the training side than we are on the they're they're upfront about it right at at Captain level, we there are things we need to train people to know how to do here. We at least say the word. We have the word College in ours. We're going to take that quite seriously. We're accredited. We're going to do all the things that we should do for education in reality. Again, I maybe should say this one, this is on, but I mean. The Pentagon wants you to be immediately employable when you leave here, which inclines them towards training more than it does towards. Education, right? Right. I mean to me that's that's critically important. It's harder to measure, right? I mean, at the end of a work college year, if you can do the things the army needs you to do, check, yes. If we did a course in art history. The measurable is a little bit harder to do right history. I mean history.

it. To people that do this stuff, it's just really. I've had this discussion with J7 people like they're like we're in support of teaching history. Help us measure it. And I I don't know how to do that. There may be a way, but I don't. Know. How to do that?

LtCol Raisch And that's maybe a little bit off topic, but semi relevant to it. Education. Especially if it's specified, if it's a a war college approach. You know, education, art history. Or what have you is. You're you're still training, you're training your.

Dr. Neiberg Yeah.

LtCol Raisch Brain to think a. Different way. Yeah, you. Are you're training? You're training your brain to? Be more flexible.

Dr. Neiberg So I would ask this as a question cause I don't know the answer, but is that really what militaries want? Right at a certain level and you know the the word to me is illustrative. They want you to form it, which is a word that I hear all the time. We need uniformity in the curriculum. Every seminar has to study the same stuff. Comprehensive exams have. There has to be. Uniformity. Yeah. When you do comprehensive exams at a civilian school, there is no uniform experience, right? You sit down with a bunch of professors and they pick your brain apart to figure out how well educated you've been. It's not how we do. It. Here. Right, so that there's an inherent tension in PM me, I guess is what I'm saying. But getting back to the flexibility issue, I think some of the technologies that are most successful. Are those that have multiple applications, the internal combustion engine can make a P51 fly and it can make a Sherman tank go. Right. That that's a that's an infinitely adaptable technology, right. Right. Well, the thing about the iPhone that I find just fascinating, it it. It is a technology that will never stop being able to find different uses in different applications because of the. Way they've set it up. Right. My father uses it to check the weather, who he knows has died in the obituaries and sports scores. That's what he uses it for. My daughters, my God, they're they're never they use. It for everything. Right. It's incredible what you can do. My entire record collection is on the thing. I will never be lost again anywhere in the world. It's incredible what you can do, right? Right. Because in everybody's pocket, it'll do something different. Right, that, that that's an adaptable technology. Something that that your privates and corporals can pick up and say, you know what? Here's a way that I can use this to do that.

Professor White I mean, is that a big deal? I mean to to pull that? String Mike is that is that a big deal because now. In the hand of the average soldier is something. That they can be innovative.

Dr. Neiberg Yeah.

Professor White Before I gave you a rifle, you can't be terribly innovative. I shoot it. I yeah, I can store a pot with it. I can do something like that, but it can't be. But now, I mean, is that a big deal?

Dr. Neiberg I think it is. I mean you see this happening in Gaza, you see it happening in Ukraine, where people are using their phones and their GPS to say, here's where the Russians are. Right. And they put it on WhatsApp. And someone's on a WhatsApp channel. There was just a story in the New York Times about this. The Israelis in in the what they call a Gaza envelope, the Israeli territory that on the other side, it's Israeli territory, but it's near Gaza. They were getting on WhatsApp groups and saying we can't communicate with the IDF. But here's where we are. We need help. Right. No one trained them how to do that? They just here's the technology. Here's a way that. I can communicate. If you if you want to some some stories have argued that that the the key difference in 1940 is not that France has worse tanks than

Germany, they they each have pretty quality, pretty good quality tanks. The difference is Germany's communications technologies are far superior.

COL Simmons Right.

Dr. Neiberg Right. The tanks can talk to each other in a way that French tanks can. Right. The Russians had the same problem in 1914. They don't have a they don't have. They're they're too big and they're they don't have a in in, in an integrated communication system. The Germans do. So in Russia, message has to go from the front all the way to Moscow and all the way back in Germany, you can just go right there. Right.

<u>**Professor White</u>** You sort of wondered. Say Ukraine now continue to pull on. But we know the Ukrainian soldiers are being very. Innovative with cell phones.</u>

Dr. Neiberg Yeah.

Professor White And all sorts of stuff the Russians aren't. Why?

Dr. Neiberg Yeah. I don't know, but my guess would be that the Ukrainians have been educated, and I mean that they are better educated than the average Russian, so they know what I mean. There's Ukrainian women that were setting up Tinder accounts and then having Russian men, you know, swipe and connect with them. Geolocate him from that and have a sniper go kill. **COL Simmons** Ohh yeah.

Dr. Neiberg Holy crap, you can't train for that. You can educate for.

<u>Professor White</u> There's that elasticity. So there's something there with creating that elasticity of mind.

LtCol Raisch Yeah, almost like a cultural thing of it. Where? Yeah.

Professor White Right, So what is that, you know?

LtCol Raisch From from an early age aren't really taught to really be creative.

Dr. Neiberg But your point, Sam, is a really, really good one. I mean, it means you have to. **Professor White** The Russians have cell phones. Are using. Them to fight the war. The Russians aren't. Why?

Dr. Neiberg It means you got to do something in basic training differently than you did when you went through, right? Here's a rifle. Learn how to shoot it. Instead, you have to say that young men and women, we're going to here. Here's some technologies. Show us what you think you can do with. That's a very different mindset as I, as you know, I'm much better than I do from when you came into the army, right? You. I got to build you down and break you back up right now. It might be. Hey. Like I do with my daughters all the time. Like teach me how I can do this with my iPhone. You know how to do it? I don't help me like my wife is doing this. Yesterday. She works for a nonprofit. They changed their logo and color scheme for the year, so she had to update the hashtag. I don't know. I I don't know. Bob and I are. We couldn't. Figure. It out my 20 year old daughter. She's. Hey, I got it. Give me the computer. I'll do it 3 minutes later. Just like here you go. You're done. You. Know.

Professor White That it is a culture. I think culture plays such a role. I mean, because we know even back, you know, even better than you know the American. The GI was a pretty enterprising. You know, we all have heard that story in Grenada where you know that they had no maps. The guy actually getting us a phone call back to his wife.

Dr. Neiberg Yeah. Yeah, it was very good.

<u>Professor White</u> Said hey, I'm here. Can you? I got a map in my desk drawer. Can you pull it out and tell me where I am? So. Put calls on a payphone back to Fort Bragg. Where am I, honey? I see this stuff around. There's this here. She's looking at a map with her.

Dr. Neiberg Yeah, I I I hope it's not just us being self congratulatory, but I I do think Americans are pretty good. At this we are. I had because your your, your, your NCO's and your officers allow that, right? Right in our system, if a private comes to you, I hope and says, hey, Sir, I think I got a better way to do this. You're going to listen.

Dr. Neiberg Right in the Russian system, my guess is you're gonna get punished for doing that. **LTC Gueller** There's some. There's some cultures that allow that, but if you watch some units, for example. What the, you know, NTC or JRTC, you know, some commanders and units are very focused and like know this is like how you're trained to do it. This is how you enter the room. This is how you do this attack versus other units like that will be more adaptive and try different things even in that environment. So like what? Allows one unit to go in there and be more adaptive and try. And the other ones, I guess almost risk adverse and just like you know, this is the way we're trained. This is the way we're going to do it.

Dr. Neiberg It is also true that in most Western militaries you need a high school diploma to be in the army and you need a you need a college degree. To be an. Officer, I don't think that's true in the. Russian army.

LTC McCray Yeah.

Dr. Neiberg Right. So I mean this is not to say that going to college makes you a better human being, but in theory it ought to open up your mind a little bit more. You know, I I saw this thing when I was doing in art history. Maybe we can apply this concept over here or something you know.

<u>COL Simmons</u> Yeah, actually one of the other things that General Anderson. Kind of talked about about the Ukraine expert. That's. Education. And it's the IT was repetition, repetition, breeding, innovation. And so he or one of the staff kind of pulled out the recent movie Grand Prix. It was like the gamer that then had done the course. And so the question to us was. Dr. Neiberg Yeah.

<u>COL Simmons</u> How do we? Get the tank crew or the Infantry Squad 1000 reps. I think that we are, I think. Generally speaking, we all said what the answer. Is like. Well, that's. That's the synthetic training environment. Yeah, we.

Dr. Neiberg We do that.

COL Simmons Were there examples during the interwar period where military organizations were trying to get many, many? Reps as they. Could like. I think that's the German. **Dr. Neiberg** Yeah.

<u>COL Simmons</u> The the Germans command staff as they thought. About hey, how do we how? Do we re envision Military operation?

Dr. Neiberg Yeah, I I would be careful about setting them again. I I don't want you to. To walk away thinking that Germans figured this problem out and everybody else was just dumb. The Germans built a military for a. Specific set. Of problems, right? Once it got away from that specific set of problems, they didn't win anything ever again. Right. What what they built was not meant to go to North Africa. It was not meant to go to Russia. It frankly wasn't meant to go to France. If they just got. Very lucky the British did start thinking about, well, if we're going to be limited to the amount of people that we have. And remember this is again where the political context comes in. When the crisis hit in World War 1, France was able to draw in Senegal. I forget. It was 58 brigades from Senegal, some huge number. And the British were able to get like 1,000,000 guys out of India. In World War 1. World War 2. That's impossible because of the political and imperial situation. So if you're France, I mean again, I I don't. I don't want to overdo this. I don't want. To overstate this. Here's the political concept if you're fragile. If you're France

in World War One, you've got ally neutral, neutral who becomes an ally. This is all Russian, and this whole thing is your ally and this empire down here is providing manpower resources 1930s. This is no longer an ally. It's now the USSR. There are no manpower resources coming out of here. This is fascist and this is. Fascist. Hey. France world it's it's not unreasonable to say the most logical solution to this problem. Is to put a. What you guys call a force multiplier in? Here. Right, because the in 1914 no French. Would have thought to do that because there's something over here that we want. Also, it's the rain or we could potentially want. So we're not gonna build a wall on the wrong side of it. Right. So I mean. One time I said this to an Air Force channel. Who got really upset with. Me. But he was making fun of the French, though they weren't. They were. And I said, look, we built this strategic defense initiative. It's the Maginot Line in the sky. Right. What we're saying to the world is we're going to put all this money into this technology that cannot hurt you. The only thing you can do is defend us. It's it's the same thing. Right. And by the way? It may have worked in the exact same way. I mean I don't know, but if the Cold War had gone, who knows? But it it forced. It forced the Soviet Union into another strategic space, and this is another thing, right? All of these innovations are dialogues, right? So the French want to build A4 engine bomber. It's actually not the French who stop it. It's actually the British who stop it. If France goes fascist, we don't want a fascist France, more ancient bombers. So they kind of go to their ally and they're like, we don't want you to do that and the. French say OK, we'll build these two engine things instead. Right. Everything's a duality. Everything's a duality. COL Simmons This. Almost like what your allies are willing to.

Dr. Neiberg And what your opponents, what your adversary is willing to do.

<u>COL Simmons</u> Right. And that's that's kind. Of your strategic arms control, right?

Dr. Neiberg Yeah, it's that. And it's if you're Taiwan. What do you want the United States to do for you to protect you? What? What? What technology does China have that it can bring into that theater? And what technology do you need to counter it? Right. I personally I don't know, but if I were the Taiwanese, I would not say I want the Marine Corps and four BCT's. That's not going to. Be the. Answer right? The answer is going to be some. Right. So again, it's going to be this kind of duality of things. What is your enemy doing and what technology do you have to either counter that or? Exceed it right. Turn the pressure on to them and that's what the 30s are about. I mean, you build a small tank, OK, is my response to build a small tank that's faster or is my response to build a bigger tank that can kill the smaller tank. Right. What do you want to do? And again, that's the question. Do you want that tank to be offensive? That argument would be for smaller and faster. Do you want it to be defensive? Like what the British think they want their tanks to do, which means the British tanks end. Up being pretty big. Right, right cause. **LtCol Raisch** Sorry, it sounds like we want, I mean. Going back to. The the thought I keep coming back to. That how how big that? Circle around, you know. The flexibility. Relates almost directly. To creativity. Yeah. You want. Want. You want problem solving? Yeah and at.

Dr. Neiberg Every level you just have to make sure you're. Solving the right problem. **LtCol Raisch** You got to solve the right, and you're probably you're probably going to have something. Trying to solve the. Wrong problem. That's going to happen.

Dr. Neiberg So I think I, I'm sorry, I mean interrupt. Sorry, but I think this was the problem. I was identifying the discomfort that I had in Israel in the summer. And again, I don't mean to make myself out to be. Sort of. In my mind, that wall was the wrong strategic answer to the problem. The problem is the right problem. How do you keep Hamas from coming into Israel and killing Israelis? I agree that's the problem. That wall is not the. Answer. Right. And for Israel? What I figured out, but I figured it out far too late to say anything intelligent this summer.

That wall was there to hold the Hamas problem off for as long as they could, so the Israeli army could go into the West Bank. They didn't have. Enough Israeli soldiers to solve both problems. **COL Simmons** At the same time.

Dr. Neiberg So hold one off while I deal with the other. The problem was they were dealing with the wrong. In fact, they were creating the problem in the West Bank, right? What they were doing was actually in my mind, mind numbingly stupid. Right. And I'm not saying that because I thought that because every answer I got from an Israeli made me clear. They didn't know what this trade off was doing, right? They they weren't clear on what the strategy. So when October 7th happened, I mean again, I'm not trying to make myself out to be clairvoyant. I was shocked, but I wasn't surprised if that makes sense. Right, you're trying to solve the wrong problem. Your creativity is in the wrong place. Right. The problem is I don't know what better answer was out there. You cannot negotiate with an organization whose stated desire is to kill all of you. Right, you can't do that. Equally, building a wall and hoping they'll just stay on the other side of it is not going to work either. Especially when what's on the other side of that wall lacks food, sewage. You know, there's nothing there. Right. Sooner or later, that's going to bite you.

LTC McCray I don't want. I don't. Want to cut shorts? Right. We we've extended time, but. Dr. Neiberg And a Blizzard coming. You gotta go and stock up.

Annex C

Transcript: Dr. Nicholas Sambaluk, Associate Research Professor, Air Force Cyber College April 2024

COL Simmons:

And then we have some subordinate questions. What were the factors that facilitated the adoption and conversions of new technologies? How is the importance of the elasticity of mind helpful in helping organizations, individuals, and cultures adapt to innovative changes? And finally, what are individual attributes and skill sets that are predicted to become increasingly important for the US military in the next 10 to 15 years? So that is our question and I'm going to turn it over perhaps to Noel, if you've got any, or actually turn it over to you, Sir, if you've got any opening comments.

Dr. Sambulak:

Sure. So I guess, sort of as an overview, but themes that help us dig into innovation in the interwar era. I'd say that one very important factor is understanding the state of the possible, the state-of-the-art, which is a much more difficult nut to crack than it sounds like, partly because when you're dealing with a security context, and you have an active adversary. If you prepare for a future that you perceive and foresee, the preparation that you undertake is going to have effects that mean other people see what you're doing and they'll likely take some sort of step that helps make that future that you perceive not happen after all or not happen quite the way that you anticipate. So, I'd say that there's sort of a time-dependent relevance in conceptualizing what is the state of the possible, and this matters in terms of what's being designed and tested and fielded. The technology that might be cutting-edge and very useful is very contextually dependent on factors that include things like geography, but also especially time. We see that in the interwar era, the way that France starts the interwar era with quite arguably the strongest Air Force, the strongest air component on the planet and yet 1940 in the six weeks campaign, it just gets absolutely knocked to the ground despite the fact that there were prototypes for testing of very modern planes coming out of allied and neutral countries then, and folks were coming up with designs that were really pretty innovative. But the sort of that time context really matters because it gives a real advantage to the aggressor as the aggressor gets to determine when a war starts, and that means they get to pick when the music stops, everybody has to find their chairs. The technology of the moment is going to end up being what people go to war with. So it's that is a challenge in making sure to have technology that is relevant to the conflict is that if you're the person who's not initiating the conflict. You have to decide whether you're always going to be ready, or whether you're going to kind of spread some of that readiness for in exchange for not having the cost of constantly updating everything. Think of the advances in rifle technology and small arms technology in the late 19th century, the Austro-Hungarian empire went through just generation after generation of rifle. That's as different innovations became possible through better metallurgy, better chemistry, and the smokeless powder, better magazines, things like that. And so there's the, the empire was left scrambling, trying to produce a new rifle in the mid-1880s then again in 1890 and 1895. Like they could never settle on one design. So there really is a very real cost involved in trying to constantly be at the forefront and one of the ramifications can be that you end up finding yourself with a grab bag of stuff that includes a few things that are modern and a lot that are incompatible with each other and also outdated. The understanding that the state of the state-of-the-art is tough, it's a changing environment and also if you're not the person who's starting a conflict. You're not in charge of when the state-of-the-art sort of clock is set. And then even folks who do start conflicts. That

advantage recedes as a war drags on or expands because there are reactions, there are responses from the aggrieved parties that before the reporting your discussion about the P51 and being able to marry a strong airframe to an engine that was much better attuned to the kind of combat that was envisioned for the Mustang, I mean, so the, I mean the mentioned the Allison engine, the Allison engine is not it's not a bad power plant but for the task that was being expected of the Mustang high altitude long range. High-performance fighter escort kind of work to keep the Luftwaffe, a fighter force at bay while escorting American bombers. The Allison was not well attuned to that mission. And so, even though it could, do, you know, good work in other contexts and, you know, work beautifully in a P38 or a P40, it wasn't a good fit for the kind of role that was being. Expected of a Mustang. But your point about being able to marry up. You know, picking, picking and choosing and bridging technologies from different countries to come up with something that actually matched the need and that was an interesting and interesting, you know one and it's a good example of how that aggressor advantage it recedes when people have. Time to react. And of course, the Germans. Pretty, pretty famously froze their aircraft models and tanks for a for a while and went to war with what they had at the last part of the interwar period and then had to kind of gin up new concepts. And so there's kind of an odd sort of gap between souped up. Measurement one of the lines and then finally being able to feel in some kind of scale. Things like first Gen. jets. It it's important. Another important theme about innovation I think is organizing and theorizing to maximize the potential of the technology is assuming that you've got some kind of handle on what is the state-of-the-art. Because technology can be very promising things, you can see accomplishments or promise or growth potential. That's very alluring. Strategic bombing doctrine is, is an example of where people saw, especially in the United States and the UK. Air power advancing in ways that were kind of breathtaking. There's the Ferdinand Foch right before rule one is sometimes quoted having reflected on the potential of aviation and essentially said that, you know. This great sport and this would probably be a useful thing to have. Some of our officers do because it gets them used to. The dangers of early, you know, flying in the 19 teens like 1910-1912, things like that, which was by no means safe. But this is not something with military potential. And some effect quotation is brought out as an example of these sort of stick-in-the-mud. Military officials who just don't get it. And in the case of posh, I think that's slightly slightly unfair because military capabilities. The military potential of aviation in the from 1910 to 1913 ERA. Was nil. These aircraft were almost universally too light to carry both a pilot and a machine gun. And they were fragile, they were slow. And so it wasn't a ridiculous comment pre-war. Anyway. The advances in aviation technology during World War One did tend to a lot of folks, especially in the US and the UK, to think well, there might be a real prospect of success or strategic bombing and certainly a repeat of one is by no means attractive. Maybe hitting the right mix of targets of key targets might deliver. Victory. The increasing capabilities of aircraft made that seem like a reasonable thing to prognosticate about. There are, but it's important to keep in mind not just the advances of the technology, but also. Where the bounds of its capabilities are, what limitations are and what are the kind of external factors might impact. The actual execution, the assumption had been in the throughout much of the interwar period that advances which were very real in the capabilities, especially like cargo and passenger aircraft which were at the time somewhat convertible to. Bomber concepts, those capabilities were growing. Planes were able to reach farther at faster speeds and carry more cargo, more passengers. There were push factors that were commercially driven in peacetime that allowed planes of that type to increase in capability and it was that the temptation was to think that kind of airplane is going to. Get faster, higher

flying, farther flying, more capable, and the pursuit planes buzzing around and trying to intercept are going to still be the kind of stuff that you see from the end of.

Dr. Sambulak:

And that was a flawed assumption. Remember, a couple of factors that did propel, I guess, bad pun, inadvertent pun, propel pursuit aviation into better capability. One was artificial and that was the trophy. Since the interwar period. The Spitfire is a good example of. Sort of the. Indirect child of these these trophy contests to try to encourage advances in in aviation. Supermarine eventually was able to take a lot of the lessons that I learned from some of these trophy contests and apply them to what ultimately and the the Superman Spitfire, and then of course the external factor in the in the latter part of the of the war period was the the darkening skies and the geopolitical climate that kind of woke folks up to the need that. To the realization there was going to be a need for. All kinds of military aviation and. That meant there was going to be budgetary support for increases in in pursuit aviation and those those factors would help mitigate. The kind of advantage that bomber proponents had seen in the Inter War era for the bomber planes would be would be just superior to their pursuit challengers. That that margin eroded for the for those reasons. You also have, I guess fairly significantly for the British, for example, the understandable sort of secrecy of radar technology. Radar was, of course, very primitive. It was just coming up at the at the dawn of of World War 2. You may have read about how. The Germans. On the on the eve of warping, declared actually ran a culvert sensing mission along the channel to try to see if there was evidence of British radar technology. And UM, didn't pick anything up and basically missed the 1st. Deployment of British radar along the coast by by just an absolute *****. And if they had sensed the the radar signals, they probably would have chalked it up to. Just radio traffic because the Germans didn't believe that somebody else could be working on a radar would be as primitive as what the what? The chain home low actually was. The the newness of British radar and the secrecy involved, I think, might help account for why bomber theorists in in Britain weren't tracking. The implications that radar was going to necessarily have in when they were launching their own missions in a conflict the the obviation of needing to have standing patrols, for example, which is very exhausting material and fuel and and equipment and exhausting personnel. UM. Getting back to sort of broader picture of of technologies, capabilities, understanding the capabilities and the limitations of. Testing of of bombing with under combat conditions was something that wasn't really completely done. They've been testing, but testing under particularly adverse conditions, not really an understanding of the resilience of targets that that, that the targets might not be hit completely, that they might be prepared, that they would have to be hit repeatedly. This is something that absolutely escaped. Inner war bomber theorists, the the and it's interesting because it's there were there were, for example, amongst American. Bombing advocates in the interwar period, there was an understanding that European weather is often cloudy. And that you're not always going to get broad, beautiful daylight, sunshine kind of conditions where you can use your use your, your. Bomb aiming apparatus and hit a target precisely. They understood that they'd be looking at maybe 6 to 8 missions a month. Because of various factors and and one of them being being weather what they didn't anticipate was that the target might react in a more capable way than they'd depreciated and might need to be hit repeatedly and so they wouldn't be knocking down 6 to 8 targets a month they'd be. Hitting those targets, perhaps, and they needed to return to a lot of them, and that was something that just had missed their. Had missed their calculus.

COL Simmons:

I did have a question like to your to your point, Sir, there was an interview, I think with the senior German general at the end of World War 2 any any kind of?

COL Simmons:

He made a made a point of saying to your point about target resiliency. I I don't think the British or the Allied forces anticipated. How much German factories were? I guess we're able to move underground and that that was a that was a significant adaptation to bombing raids and strategic bombing wasn't having or could not deliver the effects that that we really wanted.

Dr. Sambulak:

I think I think that's true. The the ability to actually aim with precision and hit a target in a way that. Was going to knock. It out permanently or semi permanently. It that was an expectation that just could not be met with the kind of technology that was available in in, in the 1930s and 40s. Certainly to half first half of the 40s the the German reaction, that's a really interesting case that you bring up the German reaction of distributing the factories and putting some of them underground really did stymie a lot of the effect of the direct effectiveness of. US attempts at precision bombing because if if the targets are all spread out, it's a lot harder to hit if they're under dirt and concrete, they're a lot harder to to damage. What to? An odd sort of byproduct of the German reaction. This is not. I mean we we can say it, this is this is an effect that that the US part of the combined bomber offensive had. But it's certainly not what the American advocates have been have been preaching. Was that the the Germans accentuated a lot of their logistical headaches by having to spread these factories out and dig extensive facility. You know, facilities underground to to put some of their factories in, in sheltered ways. That that made it a lot harder to get components of materials together, to assemble and to get raw materials to to the new factory sites it it's a, it's an interesting thing. The Germans ended up looking at what the Americans were trying to do with with the attempted precision bombing, and their response did mitigate.

COL Simmons:

The gate.

Dr. Sambulak:

The effectiveness of American bombing. But. Like most things there, there was the other side of the coin was. That the Germans accepted there were going to be additional logistical burdens in in putting in putting sort of sub components together into finished products. And the case has been made. I guess one of the notable books talks about this is rajewski's. Book from 4050 years ago now about the the German railway system during World War 2. And how it was. Under increasing strain, one of one of the many, many sources of strain as the war entered its final phases was the Germans had voluntarily spread a lot of their factory apparatuses. Out and including into underground. Facilities like you describe.

Dr. Sambulak:

Also. When when people are trying to propose new new technologies that hopefully will be more winning or will be more winning in combination with with other. You know, techniques. It's important to sort of gear their proposals to a lot of factors, and I think among those are our budgetary, industrial, personal. Geographic and strategic in terms of you know budget, one of the things that was a pretty important factor for many of the countries more than others in the Inter war era was that. The the war is is I mean the the period is bracketed by, of course, World War One and World War 2. But it's a time that's characterized especially for the democracies by. Exhaustion was from World War One. I need to return to some kind of work. Was coined in in

1920. Normalcy right, return to to some kind of normal, normal ways of ways of living. And then by the end of the 1920s, early 1930s. The stock market crash that gave way to a rather profound economic depression. And for the democracies, you know, the opinions of of people really, really mattered pretty directly through through elections. And so the the, the desire to. Pivot away from focusing every every moment's attention and every every ounce of effort into war making, as had been the case, for example, France during during the First World War, in the wake of that conflict. Like. It's very tempting for the French public to say, OK, we've got the best Air Force on the planet. We've got the biggest armored force on the planet. Would need to, you know, somehow recover from the the enormous losses in blood and treasure. And the physical reconstruction of the northeastern part of our country, what we need is, of course, reparations from Germany, but also no more, no more inflows, big influxes of cash into into the defense establishment. We've got a lot of planes. Got a lot of tanks. They're good. They're fine. They're they're state-of-the-art. And they were in 19/18/1919. Then and then you get into the sort of the Depression era and the depression hits a lot of countries. And France is a good example of how it it doesn't hit in an instant. But it it does drag in an extended period in an extended way. And that too is going to really impact French interest in military investment. Throughout the the mid 30s, fascist Italy spent more on its on its defense defense establishment than than France did. And France is putting a a rather significant fraction of its of its overall military budget into the national line, and so that that didn't leave much for for anything else, the budgetary factors, especially with the sort of economic and cultural. Sort of context really, really are an important thing to keep in mind. Also, if you're if you're looking at something like trying to mechanize. Forces. Whether it's, you know, building an armored force or trying to mechanize the logistics there, there's a lot of it in industrial questions like can, can your country build and maintain these kinds of of vehicles at scale or is it having to to buy? And if it has to buy, it does have reliable sources. Once it does build or buy, what's? It do for fuel. Would that? That, of course would really. Metastasize for the Germans, even though they were in in large measure and not not a mechanized ground force. Fuel concerns were an enduring. Problem for them. You've also got sort of personnel. Issues in terms of do do you have a population that is? Sufficiently automotive lay familiar that. That folks can can. Get into military service and. Work with vehicles without having to have a whole bunch of training. Just from the absolute scratch you know and then geographic geostrategic interests too are are, are important. Britain was alongside France, a pioneer of of tank development in World War One. Technically, you could make the case that they're they're the 1st, that the inventor. And the French? Followed slightly. In the introduction of tanks in the Inter War period, Britain did tinker with tanks. They had an experimental sort of armored force and they ran some, you know, experiments, some exercises but to. The. Concerted fielding of an armored force for for Britain in the Inter War era. Was. It it, it was mitigated. It was challenged by a lot of factors and one of some of those were, you know, an island geography and an inter war reluctance to to engage at scale on the on in, in continental Europe sort of the limited liability sense of how how Britain might pursue its. Its strategic aims in Europe, those those kind of ideas and that and that geography did not drive the British public into wanting to. Support the creation of a of a large and sustainment of of a large armored force through the interwar period on the chance that it might be, you know, needed. In a in. A in a in a future conflict. There's there's a need for innovations to to match. To to clearly match national policy and strategy, there's a. Lot of cool. Technology that might be great and might be neat, but if it doesn't, if it doesn't scratch a national pitch, there's going to be. Reluctance to spend money on it. US air power theorist so this is kind of a. An iconic example when they came up

with the strategic bombing doctrine, the high altitude precision bombing concepts that that. Blossomed more or less. At at Maxwell Air Force Maxwell Field at the time. They still and and and and they needed to match it up with some sort of technological platform that seemed capable. Of. Of embodying that you know that potential. OK, so they finally find the the B17. You know, prototypes by the mid 30s. But they still have to sell the country on the idea of buying these extraordinarily expensive aircraft. 4 engine planes were were pretty rare things and what they did because. Strategic bombing doctrine they they were developing was not. It was not. A good fit for the American mindset of the 1930s. As they shoehorn your advocacy for the B17 into the ostensible role of coast coastal defense because that. Was something that. Could be understood, could be tolerated by the US public at the time. And we're. We we see the unlimited use of B seventeens in an anti anti shipping role. For example at Midway and that. Did did not turn out well. The. There there are more, more hostile ways of of matching potential innovations to to national national strategy and national policy. Japan is a good example of this natural war era. The interest in expanding onto onto mainland Asia and also. To various places points in the in the strategic points, the Pacific. The Japanese military basically did what it wanted to do, and when politicians were insufficiently swift in in agreeing with them, Japanese military staged, you know, coups periodically or or or coup attempts that were were pretty bloody and and also assassinations of. Military and civilian leaders, who are seen as just not up with the program. And so it kind of jammed the. An aggressive strategy into the national policy by what was what's been termed as government by assassination, definitely not a not a good model. The. Another another factor that I think is is valuable for us to reflect on is reformers and visionary. These. Meshing with a larger structure and especially not alienating decision makers. Reform is a is a word that that appeals to everybody who doesn't want, you know, reform. There's a there's an implication that, like, think, things that reform would be better. But if we break the word down into just reforming stuff. Everybody wants wants to. Something, but people don't usually agree on what should be reformed or how things should be reformed. And so reformers are often not going to not going to agree with each other, and they're sometimes going to be. Frustrated when there's not. Relatively swift and universal accession to their ideas. We can and then this can kind of lure them into trying to compensate by talking louder or almost almost shrieking. An iconic example of this coming from air power, with Billy Mitchell accusing the Navy in the war. Departments of literally murderous negligence following the the crash of of US airships in storms in the in the. In 20s, that was, that was the kind of shrieking statement that was going to get import marshalled did. And, you know, turning, turning air power advocacy into a tabloid issue and a polemic that that did not do a whole bunch of favors for air power. Advocacy. Into scholars have made some pretty, I think, insightful points that in the long run, air power advocacy was better. Promoted by quieter. More constructive people who sort of colored within the lines a little bit but did advocate for an expanded role for air power and support for aviation. Then somebody screaming to the newspapers defamations of of civil and military authorities. The Gaul in his polemics. During the Inter War era, did not do any favors to the to the for France is trying to create an armored force, so making sure the visionaries are not. Counterproductive in the as a consequence of their frustrations. I think is also important now and that kind of gets to some of the some aspects of what what I think you're you all are looking at which is. How do you build a culture that is going to support support innovation and that that really has been historically a very a very challenging? Problem because the military does tend to like things that can be done. In a standardized way, and innovation is definitionally. Non standard and a non standard thing and and which are the task at hand and trying. To make a. A structure that

innovates is to somehow incorporate. And. And ability to understand changing contexts. And address those with new new tools and new techniques, and then test them and then decide what works and. Mainstream that. That that is that is a really tricky, a really tricky thing to do, sort of a last sort of vignette that I think is. Notable if we're looking at the at the inner war era, from sort of just sort of the historical broad brush. The impact of. Political hostility toward the military and suspicion toward the military can be really dangerous the most. The most profound example, I think, is Stalin's purge right you've got to writings by reformers like Tuchowski or thinking about wars. The future that are going to incorporate mechanized forces and air power and, you know, try to work through some sort of. Way to break an enemy's front and then exploit. So the precursor to what will eventually become deep battle and. This is radically stunted by the evisceration of the officer corps in installing purchased in the in the late 1930s, and that, of course, was a product of. Bolshevism was preexisting suspicion of the military instrument. Because the Bolsheviks had the simultaneously needed a military, the military, in order to retain power, can to control the Soviet Union. And yet they doubted that instruments political reliability, because in the civil war. Here at the start of the country, they had reached for a lot. Of. Talented people who were talented through their experience and training as members of the officer core of the Anshan regime, and there was never really crossed that those people were politically reliable. They they've been brought on board as a. Real politic expedient. And there was not a trust that they that they would necessarily hold to the new. Bolshevik principles. That's part of why we see the Commissar system officially, and it's official form. Runs from, you know, the end of World War One in the early 1920s, and then it's kind of rejuvenated concurrent with the purges. 1937 to 40 and then again briefly. At the outset. Of of the period of the of the German invasion. But. The the regime was constantly trying to find a way to. Make sure that the military instrument stayed Co opted and there was an existing. Presumption and mistrusting presumption about the military and especially the officer corps that that made. Lasting doctrinal conceptual changes in the Red Army much harder than they arguably would have been if if there had not been. That dynamic of mistrust. So those are some some things that I thought would be. Notable about the interwar period, I want to make sure that I'm. Speaking much as I can to sort of the kinds of things that you're. That you're working on for this for this research project. Elasticity of mind, I guess. To try to try to encourage that, that sort of mindset in. In your personnel, it's good to have broadening experiences in terms of like takeaways. I guess having having ways that personnel can get a glimpse of how things are done and or the other clients of organizations enough to kind of get their feet wet. And ruminate on it, and then bring their takeaways back to the, you know, the big service. Culturally, it's important to have. That kind of. Assignment not lead to a studied career. Later on, you know, services sometimes have different ways of reacting to people. For example, taking having a couple of years at the schoolhouse as faculty or doing various. The things that are. Not. Like a command or an XO type RTO role. So I suspect ingraining that would be would be useful. And. Let's see. Uh.

Dr. Sambulak:

What? What am I not hitting yet to that you all are interested in in talking about? I jotted down in my notes the defense innovation ecosystem and also I know there are other other pieces of this that I may not have touched yet.

LTC Chun:

Hey, Doug, can I? Go ahead and jump in real quick.

COL Simmons:

Yeah, absolutely. Because I I I am interested in the defense ecosystem or innovation ecosystem, but yeah, no, you go forward.

LTC Chun:

Hi Sir John here. So you you covered a lot of things that I really appreciate the internal the the technology and innovation.

LTC Chun:

But some of the key findings that that, you know, we've we've worked together on I'm I'm kind of interested in looking at the the quadruple Helix which you know covers government society, academic research and business and transitioning either. So my question to you is. Umm. Beyond the military sphere, what technology? Technological innovations emerged in the civilian life during the Inter War period? Because with the with the quadruple Helix against society, I don't know how much study there is and so I appreciate your insight.

Dr. Sambulak:

Oh, sure. No, that's a. That's a great question. So we're talking about technologies that might be. Applicable later on to military application or just kind of in the ether and concurrent with. With societal developments the level. Both. Pardon.

LTC Chun:

Well, yeah, both. I mean, so again, look at the studies back in the interwar period. Our goal eventually part of our project is to forecast joint force design in the next 10 to 15 years. So taking.

Dr. Sambulak:

OK.

LTC Chun:

Some lessons learned. And then applying it forward. But there's there's. Kind of, at least in my research, there's a lot of, you know, I guess the data wasn't really supporting what I was looking for to to transition forward over.

Dr. Sambulak:

OK. Gotcha. So I guess in the in the interwar period we see a lot of growth in radio technology. And in the civilian realm, this means going from sort of the dots and dashes kind of Morse code signaling things that will be useful for, you know, making sure that. Ports and ships know when to expect each other. Things like that, and in the post World War One era you start seeing the 1st. Like voice transmissions. And what does that mean for the for the? The the sectors outside the military, it does mean a revolution in entertainment. To be able to. Get a sense of. To access entertainment that more or less, regardless of your location, that's going to have a homogenizing effect on society, along ways, being able to broadcast a radio program from from New York and have. It you know. Vector onto to stations across much of the for example, much of the East Coast or east of the Mississippi, for example. Is going to end up homogenizing a lot of cultural concepts. It's also going to, of course, of course come hand in glove with an expansion in commercials. So you'll have not only things like entertainment news, but also products that become increasingly. Standardized, ubiquitous among people who live in a big swath of a country. That. Enables things like companies to to scale and different different kinds of companies to scale in ways they hadn't been able to before. You had certainly had massive corporations, things like US steel Standard Oil before, before the advent of of radio, but being able to have. A broader reach across more of the of the society does impact how other, how different companies can can scale and do different things in for example, food services and all

kinds of other gadgets and products that people might want to might want to buy. The kinds of things that are possible. For example, because of the more or less concurrent but slower expansion of electrical. So you get a lot of appliances that come out in the 20s and. Get people more used to the idea of a machine can do ex job and also to the the realities of whether the machine can actually accomplish washing the the the clothes or. You know, vacuuming things like that. So I think there's there's industrial implications, there's cultural implications that come out of out of radio. There's also. If, if, if you were interested in going into sort of like, well, where do people take it in sort of the futurist or sci-fi kind of connotations the? People thought of radio as being as having potential, that we're really kind of beyond what the potential of radio actually was. But to when the British Government first contacted Robert Watt. Want and asked him to to do. Defense research regarding radio waves. He was not tasked with coming up. With Britain's radar system. He was. He was asked. It would be possible to make a death ray. And so these sort of. Frankly, odd science fictiony ideas about what a technology might be able to do can sometimes yield fruit that is not where you expect it, because they they did the they tran the numbers and and realized that if you tried to to do it like a directed energy kind of kind of weapon in the 30s. Absolutely impossible. But what? What they they didn't notice that there. There was a there was promise in being able to perceive things in the sky that that to certain. Sort of. Signal return phenomena that have been recognized or identified in in past decades with radio signals might be something that could be. Systematized and turned into a reliable way of of sensing when there's something like an airplane in the sky, and so radar comes out of. The studies about, you know. Miracle weapons that were themselves inspired by somebody having kind of a sci-fi. To hunch about. Advances in radio technology. We talked a little bit about about aviation in a military context kind of circling back to to what it to to aviation in the civilian realm. UM. It was still very much the. The preserve of folks with with serious money to go doing something like air travel, but it was expanding from nothing into something the first commercial passenger. Your. Route, I believe was by Handley Page, the British bomber manufacturer in, I think, 1919. Certainly, that was the first time that anybody brought. Like an an ear meal on a on a passenger flight. And that's pretty quick. after World War One. The. Commercial possibilities of being able to move people or freight that were. Critical or expensive? Quickly. Encourages advances in certain elements of the aviation sector. That, That is important for getting the public used to the concept of flight as a sign of technological progress. There's a lot of a lot of cities that started breaking ground for municipal airports. That in in the in the immediate aftermath of Lindbergh's flight, and this is this guy just ties growth in the aviation sector with one element of something we're talking about before, which was those those trophy contests, the trophy contest that, that. Charles Lindbergh was chasing in in order to make a. A continuous. Transatlantic flight. Did bring a lot of notoriety to the potential aviation and in the late 1920s you see a lot of cities decide, OK, we're going to, we're going to buy a patch of land, farmland adjacent to the town, and we're going to try to make a Municipal Airport. And in some of these instances Lindbergh, when he came back-to-back to the states, traveled around the country and and showed up at some of these places that that will end up bearing fruit. As we get into not the interwar era per se, but as we get into the the part of World War 2 where Europe is is at war and the United States is still technically neutral, but the the US begins a radical expansion of its. Aviation potential around 1940 in the in the wake of of the fall of France, you see statements by, for example, Franklin Roosevelt talking about we need to build 50,000 planes, right. And then the the military advisors folks like George Marshall say yeah. Air power and aviation is not just about airframes. You need to have pilots. You need to have places to land, you need to have

support facilities, you need to have technicians and mechanics you need. There's a lot of other things that we need to make. You can't just build airframes and decide the rest for clones itself, one of the. Upshots of this. Was the creation and expansion of civilian pilot training programs across the United States. There are about 3000, about 3000 of these, ultimately that were set up. The Tuskegee Airmen, of course, is probably the most famous one, right that that kind of ends up creating iconic ear unit. But there are about 3000 different schools across the country that were preparing civilian aviators. By 194041 and that was something that was both useful in World War 2 because having having enough people, you know. In the facilities to start preparing pilots at scale was obviously going to be important in World War 2, but also those facilities could have could exist because there were a lot of airports that were set up. 10 years earlier. As a. Local popular reaction to the Prestige flight that that Lindbergh had made, and that that was something that was, we can kind of indirectly pull the thread and see a connection between some of those those trophy contests and a general culture of. Enthusiasm and support for an expanded role of aviation. Another ERA area that I think is is maybe useful for us to think about in sort of the government, societal, economic, economic, business kind of thing would be advances in electronics and in commute computing. The person who ends up hitting the. Office of Scientific Research and Development, which the RAD Lab that you were mentioning. I remember this before, like rafter the Gray started. But the the Radley was one of many offices that worked underneath the Office of Scientific Research and Development during the War Two and this was headed by. Jennifer Bush, who was a. Dr. Sambulak An an inventor technologist at MIT, the the advances in. Electronic gadgetry and also in the promise of maybe being able to come up with something that would. Be recognizable to us as a computer, as a very early computer. That's something that emerges in the in the inner war era, and that is not driven by military investment. That is, that is something that is predominantly inventors thinking, that there will be. Business and academic. Applications. And then it has borne enough fruit that by the time World War 2 emerges and it is and is well underway, we start seeing things like the British building Colossus to try to help, you know, crack enigma, the Americans building their their early computers to. Do the calculations for gun ray tables, that is. Really, when we get to early computing, that is government. On behalf of the military. Adopting and progressing. Technological A technological base that has grown up from a context well outside it's it's boundaries, boundaries. I hope that's is that is that useful that to. Hopefully useful.

LTC Chun:

Yeah. No, that was perfect. There I will pass it on to my peers there. I know they have a. Dr. Sambulak Cool. OK. LTC Chun Lot of questions too. Dr. Sambulak Let's see. I think we're we're coming up at 9:30. Other than closing, yeah. COL Simmons Christa, I know you had some culture, if you? Had a culture question. LTC Gueller Yeah, sure. So I had some, I was looking at culture and you hit on a lot of that. I was also looking at within culture, career flexibility and the impact of like PM me and the personnel management pieces. So can you provide like a good historical example of how? PM me can hinder or encourage innovation, specifically from the interwar period. Dr. Sambulak That's a good question. I I guess I'd say that. There's there's a good there's a good book on Fort Leavenworth's history. I think it's called a school for war by Peter Schiffer. It was a past few years ago that does a good job of kind of exploring what the. Experience was of of officers in in PME during the 30s. Specifically, he's he's really focused on love and worth and sort of the culture of. Not. Not exactly cut throat competition, but everybody was trying. Everybody the school was trying to rise to the top through that the best they could and that kind of helped build better leaders, I'd say. I guess in terms of a. More innovation

oriented context, I'd say the. The the Industrial Work College setting up the Industrial Work College after World War One. Is a reflection of. The US military coming out of that conflict with a realization that war. Over. In the 20th century was going to be pretty different from what they've encountered before. There's a there's a recurring. Problem that that keeps showing up in in, in in conflicts very often which is that they tend to of course go longer than we than we want to or anticipate. And they also cost a lot more in terms of people and materials and money. But it it, it really is pretty, pretty phenomenal looking at the rate of of use of material. Like. Artillery ammunition, for example. The Battle of Life Saga from number right in 1813 was the biggest land battle. In human history, and this was one of the one of the last. Clashes of Napoleon's forces against the Allied armies in during his career. And it would be, it would remain the biggest battle in human history until the Japanese, the Russia, Japanese War. And the Russian Japanese war had two separate battles that each were bigger than Leipzig, and this is a war that we tend to think of as sort of a footnote. Like I am the Russian Japanese war in the Balkans, and there's World War. But it's it's that was a that was a pretty enormous conflict in its own right. And one of the things that the Japanese leaders found very quickly is that the artillery stockpile they had made, which was vastly bigger than they had thought they would need and vastly bigger than. Than what they brought to the to the, to the party when they were fighting their previous war a decade earlier against China. They they ran through that in a hurry and they found themselves pulling ammunition stocks from the from the home islands and trying to ramp up production in a desperate, desperate bid to somehow keep abreast of what they were, what they were burning by by flying off the artillery tubes 10 years later. The European powers, which had sent something like 80 antichains to go watch the Russian Japanese war are going through artillery ammunition at the start of World War One at a rate that and I'm going from memory here, but I believe that there were French gun crews. That were expending ammunition at the outset of World War One. Where? If if this. Continued at scale, the French army would have no more artillery ammunition in a day. And so we're both sides of the radically scramble to to keep production up to the implications of that happening and creation of new new government ministries in Britain, for example, give helps indirectly give Winston Churchill bigger, bigger foothold in the political sphere. And this is not this is not some, you know, thing of the the gone past. We can look at the rates of of artillery expenditure in in the Russian Ukraine conflict people Co through stuff way, way faster than they than they think they will well the the realization. About that in World War One did lead to the the formation of the Industrial War College. In the United States, and I'd say, that would probably be. Where I would start in terms of trying to find a linkage between us PME and realizations. There would need to be a need for. Serious change in sort of the industrial and innovation and technology sphere about how the United States fought war and and thought about war. LTC Gueller That's very helpful. Thank you. COL Simmons We'll go to go to Mike. LTC McCray Hey Sir, can you, can you hear me alright? Dr. Sambulak Yep, Yep, I can hear you. LTC McCray Hey, appreciate. So appreciate you mentioning Billy Mitchell and some of us have have looked at a number of of of significant leaders during the interwar period both on the US side and and perhaps even Guardian. When it comes to to blitz. Appreciate write you mentioning, you know touching on the elasticity of mind and the broadening experiences and things like that. But specific to the interwar period, do you have any recommendations as to you know kind of you? Know. Who are the top 2 quintessential? You know, leaders of the time. That you would recommend looking into when it comes to elasticity of mind over. LTC McCray Cognitive flexibility or anything. Dr. Sambulak There is a a naval leader who is mine. His name escapes me at the moment, but he was pretty important in the

1920s for helping to kind of usher in US. Perspectives on how to use carrier aviation. LTC McCray Yeah. Would that be Admiral Bull Halsey, Sir, or? Dr. Sambulak No, he's actually before Halsey Halls is not a bad one to to have there, though I can. I can picture his face and I can't think of this thing. I can't think of his name. COL Simmons OK, OK. Dr. Sambulak I may have to have to e-mail. As a follow up on that. COL Simmons Would that be George Dewey? Dr. Sambulak Dewey is an important one too, but this guy specifically had a had a career on on carriers in the 1920s and he was pretty important for the 1920s. With what the Navy did during the interwar period was a series of a fleet and. By and large, these entailed having a a. A red force and and a blue force face off against each other and guite frequently this was simulating some kind of raid like on the in Hawaii or especially on the on the Panama Canal. And this guy was one of the people who helped lead US naval. Practices and thinking into recognizing that maybe these aircraft carriers could be useful not just in in the individual contacts, but maybe you'd want to have them have them pair up and and maximize their potential to to to hit something. In either era. There was a lot of. Thought that went into well. What? What is naval? Aviation. Good for. Because a torpedo is something pretty heavy and the the carrying capacity of aircraft, even by the latter stages of World War One, was pretty finite. And so having. Some kind of a biplane that could that could. Half the torpedo into the air. Was it was a big ask. And not just that. The way that the landing gear and the axles on on most aircraft of the era was situated there was no place to put the torpedo and so you actually had to adjust the the landing gear itself in a way that tended to. In it, the British went through quite a few aircraft. I think the Rockburn company testing different airframes to try to try to beat torpedo bombers and what came out of out of these tests done by the Americans, the Brits, the, the Japanese. With a lot of folks thinking, you know, aircraft are pretty fragile, they can't really carry a whole bunch. They don't have a lot of punch and they didn't. And in the in the first years after World War One. And the and this is. This is the kind of the kind of perspective that led to a lot of folks tending to to adhere to the existing big gun philosophy of battleships are not going to be. Replaced by aircraft. And it's very easy. Later on, you know, after after World War 2, it's easy for us to to look at this and think that was. Really antiquated thinking that it didn't understand the capacity of something like a Pearl Harbor attack. You know, massing multiple aircraft carriers. To to Rick. Demonstrate devastation on on warships that you know can't defend themselves from heritage. That that sounds nice, but it it does kind of oversimplify a lot of the dynamics at hand. There's a book by Laura's calendar called how How Carriers bought. It's not another war book. It's a. World War 2. Book, but it's it's a it's an interesting. And it it talks about how. Not just how capable, but also. How fragile your craft carrier still wore in the 1940s. The The the school that was believing in for the big gun Navy it there were arguments to make in its in its favor. A battleship is not going to be nearly as affected by bad weather or darkness as an aircraft carrier. That pretty much there's no OPS if if there if there's a bad wind, if there's no wind, if there's dark skies, if the. A storm. A carrier is not going to do anything in in the interwar period. And very seldom did aircraft carriers do much of anything in those kind of conditions. In World War 2 either I mean if there if there was a storm going on or if there was darkness. There was probably not going to be aircraft carrier operations. You might be able to. Think of a. Couple of exceptions, but that's generally because they're exceptions. I mean, Taranto, the British Red Taranto was an exception. Some of the latter phase. Stuff in the. The in the Marianas, where the where the Americans vectored off aircraft they knew would have to land in the dark. That was that was a bold move, and that was just landing in the dark. That wasn't that. Wasn't doing the whole mission. But so there was, there was a lot of skepticism about the capabilities of of

aircraft, partly because of what aircraft could do through most of the Inter War era, being rather limited and also the number of capable aircraft carriers was pretty finite too. The the cube with high the the force that to. The the six carriers that end up going to Pearl Harbor to to do their thing, that was only organized in the around the middle of 1941. There there, there was no such thing as a in any country anywhere of a standing force of multiple. Significant sized aircraft carriers anywhere in the planet until mid mid 41. And so this this person I'm. I still can't think this name off. I'll have to get an e-mail to you. His work with trying to experiment with the capabilities of two aircraft carriers in the 1920s really was pretty, pretty revolutionary. So I I think I put him as a I guess a flexible, a flexibly minded leader. UM. In a sense, I guess. Guderian is is a is a famous one, but Guderian also gets rightly in in some ways rightly run down for having poached a lot of ideas from other people. Including a man named Watts in the German army who was arguably more important for trying to do early, mechanized. In in the in the the inner War German Army, I guess you can say that in a sense George Patton was a a flexibly minded person because he was able to. Shift away from his advocacy of the horse cavalry and start adopting mechanization. Several sort of figures of that of that to. Of that sort.

LTC McCray:

Hey, Sir, really appreciate it. Thanks. Thanks so much.

COL Simmons:

Mike, do you have anything else?

LTC McCray:

Sorry about that. No, please, please, please. Move on to the next person.

COL Simmons:

Hey, Kelly, you're you're next.

Lt Col Raisch:

Copy. Thank you, Sir. I don't really have anything specific. I think you kind of touched on what's already nested within the key findings. Again, mine is related to strategic vision and preparedness. And you'd mentioned a couple different places. Where without a you know sort of a a national mandate or direction or directive to to tie certain innovations, ideas, you know you got. To have a a problem. To solve, you got to have a problem for a solution. In order for that to work out and I think you kind of. Based on that, what I've also found is and you touched on it a little bit as well, maybe not directly. Is the idea of the strategic vision and funding or resources in general, where if it if it's not directly tied or can can link back to a some sort of national level or state vision, it is less likely to. To kind of carry forward, that doesn't mean it necessarily dies on the vine. It might get shelved and and pulled off later. Some do die on mine, but that that was kind. Of. The one one of the things where it's without the vision that when there is a vision, the funding usually follows, not always. Usually it's kind of what I noticed and once. That division is honed in at the outset of some sort of conflict from a US standpoint, you'll notice that the the funding, the ideas, innovation generally flows freely from that point on, it's just a matter of having the right things in the hopper once that moment gets off. Is kind of what I found. Dr. Sambulak:

Yeah, I think that's fair the. Sometimes the the the idea is do I kind of have to terminate for a while before? Before the context is ready or the OR the public is ready, or the geopolitical. You know, picture kind of makes the makes the spigot turn looking into sort of the the Marine Corps Proto amphibious assault doctrines that emerge well before and early form well before the Marine Corps. It has to start storming, you know, beaches in in the Central Pacific. Like I think it's it's an example of that and of course that means that let people ruminating about what

kind of crack should people be jumping out of when they when they go making an assault. And that takes a while to end up getting towards the Higgins boats and the the alligator type type craft. I guess making sure that there's a way to keep, UM. To to keep those folks who who who got visions like that. UM. In in the running, make sure they're that their careers don't get sidelined is important in a kind of an odd way. That that is hard to do. Both because institutions don't tend to like. Folks who were UM. It's kind of odd or seemingly odd or obstreperous or whatever, but also it could be difficult at times to know where the key the key job is going to be. When when Hugh doubting was put in command of and put in charge of British fighter command. UM. That was not seen as a real career maker assignment that was comparatively A backwater. He he had been. He's been trying to get to to the, to head the Air Force in general, and that was seen when he was named very much as a consolation prize. And it turned out that that ended up being not just the right place for him, because he his ideas did. Suit Britain's needs in fighter command, especially in the summer and early early fall of 1940, but also that would end up being the commanded arguably had. The biggest role in. Preventing at least an attempt of German invasion. And nobody, nobody put him in that job because they thought he was a good reformer and he'd be he'd be able to make a real difference there he was. He was put there as a, as a consolation. And so it's. Well, it's important to make sure that folks don't get their careers wrecked for having ideas that are a little. Unconventional. Where they end up getting positioned next. Can have impacts that are that are not necessarily what people mean when they when they put them there. That's that's probably. I don't know how helpful that is, but it, but it is kind of. I think born out in some of the history, the, the, the name of that naval guy was Joseph Reeves. It took me a minute. But that was the the carrier, the carrier theorist.

Lt Col Raisch:

Thank you, Sir, that that definitely ties in. Not only my, you know, kind of key finding area that I'm working on right now, but you know ties it to some of the others in terms of having the right elastic thinkers having the right, the right culture within a larger ecosystem that, that, that. Carries the right people to connect visions to resources and to the future, to the right, folks to. Ruminate at at the right times.

Dr. Sambulak:

It is important to to make sure that that the environment does have room for for folks to. To play with ideas in an earnest way. And that's probably especially true when the. When the security environment has got a lot of ambiguity to it.

Lt Col Raisch:

Concur. Thank you, Sir.

COL Simmons:

All right, Sir, this is Doug. I guess I got the last question on defense innovation ecosystem. I'm glad you you brought up. Osrs D as I found that was really interesting is an outcropping of outcropping of the National Defense Research Council. And and then I I was looking into the Britain's Department of Science and Industrial Research and the Tizzard mission for for me, I'm I'm going to use the defense ecosystem system to stitch a lot of our key findings.

Dr. Sambulak:

Yes.

COL Simmons:

Together about the importance of culture elasticity of mind strategic vision. And in forming a healthy ecosystem that can can can innovate to produce an enduring military advantage, one of the things that struck me, and I just kind of my question really is the potential for international

defense innovation ecosystems. And the reason I ask it that way. Is because the book I was reading, Churchill's Arsenal, Churchill, and America's arsenal, it, it seemed to me at least from the authors perspective, that. Neither America, France or Britain possessed the. Domestic innovation potential to really amount A to mount a a military effort capable of defeating Germany through, you know through a number of different factors. Strategic geography, economic and and so on and so forth. But once the. Once they were able to begin to collaborate, there seemed to be a, you know, just these. Tidal wave of advancements, both from what the British shared with America and then America harnessing its own, unthreatened industrial power, and so, so that was my question to you is. Is there something there or is is you know is it best to think of the defense innovation ecosystem as wholly a domestic domestic item for for just nations to consider?

Dr. Sambulak:

That's a great question, I'd say. Sort of sort of. Both and sort of contextually dependent and thinking about about the history here because. Certainly in World War 2 you do start seeing a a snowball effect. Of people who. Bring their their talents, their expertise, their experiences. And and sometimes. They're they're genius into the into the mix to make things that would not have been remotely in the. Within the purview of of a single country, the Manhattan Project, which is sort of the hot ball exception, like OSD, oversaw basically all the US S&T efforts in World War 2 except the bomb, which is a, which is a really odd one, but it it has to do with with Vannevar Bush's take on. The the timeline in which. That technology, he thought, would be, could be fielded, and it Bush is a fantastic, fantastic, interesting person, but. The The Manhattan Project is a good example of exactly what you're describing that the the US built. You know, a nuclear bomb, but the US built nuclear bomb. In large measure, because of an access to, you know lizard from Hungary, farming from Italy, people who have been. You know. Literally thrown away or or or expelled or or were rebuffed by the horrific policies of the Axis countries. And they found they found a more a freer environment in which to work. They and they were able to put their put their talents to use and helped make possible something like like the the Manhattan Project. You end up getting. Much more capability when people can collaborate across. Collaborating in in various ways, whether it's across disciplines or as we're talking about here across countries. The. The Allies were able to pull that off during World War Two, I would say in large measure because. The. Murderous and repugnant policies of the axis. Drove them into alignment with each other. And I think. Part of why we don't see more collaboration in the 1930s by the. Future allied powers. Is that there? It's not clear that there is a need to to open the kimono to each other because it really there there's a lot of vulnerability in collaborating with other countries about the about what are the science and technology secrets that this is our mission that you mentioned. That was a bold move because it really was Britain presenting some of its best S&T's accomplishments as a. Good faith offer down payment however you want to put it. Were the United States to to cooperate? But if the United States had not decided to do that? Britain could have given away a lot of a lot of its the fruits of its know how. And and. There are times where it where it kind of backfires. I mean, the British shared this. This is a an example that kind of gets brought up quite a bit the British. Delivered to the Americans. The bulk of their of their expertise and discoveries on Jet Propulsion. And they did not get anything shared back with them. And that bit them pretty hard in the post war post World War 2 era and so. In order for for an international defense ecosystem to really emerge. There has to be some kind of political environment or context. That is sufficient to make countries actually decide we're going to. We're going to cooperate. We're going to collaborate, we're going to bring. UM. Potentially

the best, the best discoveries we have, the, the stuff that is most cutting edge most potentially impactful. Had been potentially the most secret, and we're going to share it with somebody outside, outside the fence that it, it takes a lot to get there and that's that's something that just was not. Really. On the car, it's neither war era. I think we can, we can say that. One of the advantages of having things like the Five Eyes, you know, the kind of dynamics that that emerged as a result of. The World War 2 experience of the Cold War realities is that it is more possible to to collaborate across national borders. On significant technologies or Intel you know and and confluence, those things of those areas. Much more possible now than it was in the Inter War era. The the sense of needing to keep keep your national secrets national. I think I think a good example of this. Is. How the Belgians knew from experience that if there's a war in Europe between Germany and France, somebody is likely to invade Belgium. And with the building of the national line and along the Franco German frontier. Debt. Further raise the prospects that if there's going to be a fight between Germany and France. It's going to happen at least partly in Belgium and at the same time. The Belgians closed their borders to French military observers. They didn't cooperate and collaborate with the French on. Even where they planned to make a defensive line in the event of a German invasion, let alone, you know, sharing. Secrets from their you know industrial base or their S&T sector or anything like that. It was just it was a different mindset in the Inter War era and I think that that sea change. That delivers things like the Mustang, like the, you know, the atomic bomb. Like for the US perspective advances in in, in jet engine technology. It is unlocked by. The world confronting World War Two was, but really doesn't have a particularly good close. Example of a counterpart in in the. Inner war era. And when the British and the French were each working on tanks in World War One, they were pretty much following their own their own drummer. I mean, they they had some attaches aware of each other's projects, but you can see it in the technologies the British are doing the their their own thing. The French are doing their own thing. Conceptually, in the design, in the application and in the employment they're tracking nationally, they might be holding adjacent sectors of the front, but they're really not cross pollinating the way that the way that we see during World War 2 and. And afterwards. So I think that's.

COL Simmons:

And would like to ask you. Yeah, no, I would like to ask you about that going off on a slide that in some of our research we I became aware of the the.

Dr. Sambulak:

Maybe an example?

COL Simmons:

The depth at which Germany and the Soviet. Union practiced and trained together and I called. I called out the examples of. So you had Germans mobile warfare, you know, the its success was then evident in the first initial stages of invading Poland and then France and then the the the. The fruits of that collaboration for the Soviet Union seemed to immediately bear fruits in the the Russo Japanese War and Mongolia, where Russia did beat Japan in that in that war, and that was kind of the first kind of opportunities to validate. The battle, from what I think the and how the Russians envisioned.

COL Simmons:

And so that was to me that was kind of an example of international collaboration, but unfortunately it wasn't an innovation ecosystem as far as like the research and development, it was more of a sharing of concepts and.

Dr. Sambulak:

Great.

COL Simmons:

Is and training so the. So thank you for kind of like talking about like I I I don't think I fully appreciated how much the perception, the threat perception guides the risk taking in international collaboration.

Dr. Sambulak:

In. It really it really does. And Kazan, if, if if I'm gonna have to hop off in a in a couple months. But I do want to say something about Jason said, that's a really important example you bring up. The the Germans felt when they when they went out to to those facilities that were in the Soviet Union, they were they were doing their own thing. They were aware to some degree that the Soviets were spying on. But the the Soviets weren't there to. I mean, ostensibly, the Germans weren't sharing a whole bunch of information with the Soviets, but the Soviets were certainly watching, and the Germans knew that they were watching. To some degree. The the Germans did not feel that they were there to learn from the Soviets. By and large, this is research that's come out pretty, pretty recently. The Soviets, for their part. Although they do, there were a lot of folks making a lot of takeaways. And and certainly Zukov makes his a very, very impressive sort of debut in that Russian Japanese conflict at. A lot of the people who were who are on the Soviet side, watching what the Germans are doing at places like Kazan fall, victims of purges and are actually of of higher they are, they are more highly suspect in the in the eyes of the Soviet. Policymakers, because they were. Next to Germans and potentially tainted it, which is it's a. Real. Quirky thing that they that the Soviets from the purchase come around. Actually take a an even dimmer view of the people who were in their in their ranks and were liaising with those with those German experimenters. So yeah, the the the sort of the the. Sense of where, where our national interest and what and what are the national risks is a fascinating dynamic. And I think that's a that's a really good thing to point to.

COL Simmons:

If I could ask one final question, just very quickly, the a lot of a lot of our our, our, our characters that we are pulling out of the interwar period and the visionaries for innovation change they are like in I think in some of Kelly's examples they are attaches viewing Japanese amphibious. Devious operations, we we talked about Billy Mitchell and his experiences in World War One and then, you know, you've got. And I was pulling out Marshall to to Scott Ski from Russia in this deep battle. I asked that I asked this question this way. They they all had very graphic conflict experiences that motivated them to to see battle differently and and when we project in the next 10-15 years. Are the conflicts of Afghanistan and Iraq sufficient to help us have the emotional motivation to envision battle differently?

Dr. Sambulak:

That's a really good question I.

Dr. Sambulak:

I would be skeptical. But to uh, but I I'd certainly be interested in, you know, their in their perspectives. I think that there is something. Pretty different in a a, presuming that the. Next. Conflict is something. Broadly along the lines of a of a of a GPC kind of dynamic. I think there's a there's going to be a lot of disjunctures. UM. But uh. But I'd be interested in other perspectives on that too.

COL Simmons:

Thank you, Sir. Yeah, because it just it was seeming that a common theme in innovation is a a visceral emotional experience.

COL Simmons:

And we. You we we look at what just happened in Israel as far as the volume of fire that that added that Iran fired at Israel, the constantly the experiences in Ukraine, Russia, Ukraine and then you have Israel and Gaza. I I only ask is do you, you know do we have the sufficient amount of. Attaches and observers to collect. The the lessons of going on, much like what I think what I think I see. In like the Spanish. Civil war if you participated in the Spanish Civil War, you got a free Rep in the game, and if you didn't, you were. You were that much you that more behind in your experimentation.

COL Simmons:

And conceptual thought of what the future battle was. Or could be.

Dr. Sambulak:

I think I think that's a good. That's a good. A good point. A good comparison I I hope to have and we do have a lot of folks. I don't know what the numbers are, but I hope I hope we have a lot of folks who are. Watching, watching these these conflicts. An attentive and. Approximate way, because I think there's. There's a lot to learn from what's going on and whether it's yeah, Israel deflecting mass air attacks or or things going on in the Red Sea or across across Ukraine and and the also the the the rates are going on in Russia, these are. That they they bear some serious attention. I I hope that was that was helpful. I really I enjoyed getting getting to to speak with you. It was. It was a lot of fun and this is a cool a cool project color working.

COL Simmons:

Sir, I want to say thank you very much for your time. This is I think this has been an exceptional interview. Thanks for we're almost two hours. I know this wasn't kind of planned, but we I think we truly appreciate your time and helping us. Kind of at work towards the later stages of this project and I think all of us are now much more steeped in the historical context as of the inner work period, and I really I think we all appreciate your your expertise in the military innovation too, because that was that was really helpful to kind of help link the two together. Historical natures of what we're looking for and kind of looking at in military innovation trends. So thank you very much.

Annex D

David Christensen, Air Defense Artillery Historian, Fort Sill, OK April 2024

David Christensen

Little bit about me serving the army for 40 years now have been an instructor at the command and General Staff College. I did do Quantico and Fit Warfare School as opposed to the army was filled artillery officer signal officer and spent most of my time with special forces units only because I was at Bragg in 86 when the JFK Center. Become Special Operations command and then spent time in Germany, Stuttgart and Heidelberg. Instructing is what I do. Historian 5X and. Who was the? Other one I had something in common with. I'll probably get back to that, but. I did read more chasm or the premise of it. I I remember that coming out and if I told y'all to read a book like every good historian tells you read a book, there's another great historian who taught quantum physics at Harvard. His name's Thomas Kuhn.

David Christensen

Promise you yeah. Kuhn. He sets it up. His readings. He published in 62, and it was. Forget the titles and scientific and Revolution of technology, or something that effect, but his work in 62 helped Admiral Zumwalt, Lemay, and. At the time, the army especially, you know, star, come up with ideologies. That man, we gotta start modernizing and using tune as a template. And he's the one that's not everybody thinks Steve Covey, some successful business traits. Coined the phrase paradigm. It's actually Thomas Kuhn back in 62 that and he and he got us to try to think innovation as a paradigm shift trying to take a quantum leap if you would, because he was a physicist and thinking outside the box. Now if I took his practicum and I put it into 19/19/19. 39 The only officer in the United States Department of Defense in that time frame that probably was exercising. That is Lieutenant Colonel George C. Social. And I don't know if you guys studied them as part of your project or not and what. He was doing at Fort Benning. Now do I get a thumbs up?

COL Simmons

Yep, I actually we haven't. We didn't study him directly, but I read a I read a a naval.

David Christensen

Or not really.

COL Simmons

Naval Defense University article about George C Marshall and Marshall was writing a lot of interesting publications about armor warfare at the early part of the interwar period and. Before Marshall became, I think he was the Commandant of the Infantry School. But when he was an instructor there, he was told to stop writing because his ideas were going against doctrine and the army, the Army Infantry School did not appreciate that.

David Christensen

And that's all true. And it's not too he's a Lieutenant Colonel now he's the deputy commandant that he gets to take what he wanted to do as a student, and he has this school solution. He's supposed to teach. And he teaches it like he should. But he challenges students to. I'm trying to think of what Kirk did during his experiment, but think outside the box and challenge the school solution and come up with better. Solutions. And whatever students did, you know, you got a name for following the school solution or coming up with the school solution. But your paper would get published and and the class had to read your paper if you had. Other ways of thinking about a problem set that when it gets. That. That thinking that dogmatic thinking, if you would. COL Simmons

So yeah, kind of like the historical example of encouraging creativity and what we'll use as elasticity of the mind, independent thinking, adaptive and creative thinking to solve problems. That that don't necessarily are easily answerable by doctrine or finding finding new ways to solve problems outside of doctrine.

David Christensen

Yeah. And I'll tell you, even in my career time frame, I've watched. Some of them, some of our army leadership and Department of Defense leadership right to follow.

Speaker

That.

David Christensen

And get chastised Zumwalts Navy of the 70s, just in suckers. Beret BC for brigade Combat Teams, unit of effort, Unit of Action Task Force 21. Some were successful. You know, the seven big builds for the army when we did the Apache, the Abrams. The patriot. And and it just I can't explain and I don't think anybody ever will. When are we accepting adaptive leaders and when are we not?

Speaker

OK.

David Christensen

Your time period that you're focused on though 1919 to 1939, the hardest thing is that you know, we got a depression going on. We got a Dust Bowl going on. There are things that inhibit. DoD because the budgets only \$300 million, that's about 1/3 of what we need to run the force. And oh, by the way, when you take how big the force was, the Navy Department, Navy, Department of Army, to include the Marines and the. Department of Navy. They were only 50% strength at the enlisted and the quarter percent strength that the officer ranks for even what they had fielded, and that 300 million was of. 1/3 of what they needed. So although you had all these thinkers, everything's getting cast aside. Even now go to 1936, the Germans are practicing compound warfare right from from 36 to 39. They're in the Spanish Civil War, practicing their compound warfare. We have anti shades just like today. We have anti shades in Ukraine and we've got thinkers and.

COL Simmons

Yeah. OK.

David Christensen

And we're watching Ukraine. Fight is something that we haven't thought, you know, in forever. And but their TTPS where you're dismissing try to get and you can identify with this dog and I hope your rootkit try to get patriot officers to train like Ukraine officers on detecting a signature, firing it, turn everything off and quickly move. You know or predicting. We we don't train even though we know that's necessary to defeat the enemy in large scale operations that the Ukrainians, in order to survive our pricing at everything we did is dismissed. We got kids engaging drones in theater today, right?

COL Simmons

Yeah. So that, yeah.

David Christensen

Why did?

COL Simmons

That that might be something we follow through Dave, on our report out to the J7 is you know the A, a measure of military curriculum and how adaptive is it or how fast it can change

following the George. The Marshall example and vignette and history. And then we say this as a as a sa a finding you know. We need to we need to have curriculum or we need to have institutions that are able to adapt a little more nimbly to the environment than we have than what we have right now.

David Christensen

Right, right. And and that's where and not Lieutenant Colonel Marshall. How do you leverage Captain Marshall, who's already doing it as an SG small group instructor and he leverage him not to have to teach. But hey, take your experiences from World War One. Speaker

As far as one of the feedbacks. I got from one before that. He sent back. Us again. David Christensen

And and what we know is capable and and with armor and be able to. Teach that now, rather than wait for three National Guard kids to get hit by a drone, you know. Yeah, we we do stifle it. So on 3639, everything we knew about Germany, we didn't practice till after Poland. What other innovations from 1919 to 1939, you know you got, you practiced armor, you practiced chemical right? You practice anti aircraft. All these things you practiced and will will want prior to 1919. But other innovation thing that's happening other than Marshall now he's mentally the material side is the Navy with the carrier in San Diego. And and think of the kids name. Uh. Leave. COL Simmons

Oh, Billy Mitchell. No, no, no. Yeah. Because Billy Mitchell was more. Was the Army Air service. Are you thinking about the the Navy like Navy guys?

David Christensen

Billy Mitchell. Right. So you got Navy, but you got Billy Mitchell saying the same thing. The Navy is Navy's telling you I could take a platform out the sea and have a flotilla. You, you know, and engage targets closer because I can take the fight. To the enemy, the Navy is, and so is the army in 1920. By the only preceptor to World War 2 that we foresaw was we knew the Japanese were going to be a belligerent nation, that we had to face. We knew that we were dismissing Europe a little bit, even though all our TTP's were Europe and the army. But the Navy, TTP's and some of the army. Was pushing towards that Operation Rainbow or planned Rainbow? COL Simmons

Yeah, the, the, the rainbow plans and Operation Orange or Orange was the Japanese plan. David Christensen

Check, yeah. And we fought those. And we built, took battleships and scraped. Them have built flat tops if you would. Now something different 19/19/1939 was. The price that you paid, you know if you took the Louisiana maneuvers, almost 30 soldiers had killed. If you took what the Navy was doing on the West Coast, lot of sailors and pilots were killed. Even here at Fort Sill, we stood up first Aero Squadron. But that was the price. That was a recognized, accepted risk for the military at that time and space. You got to take that equation out today, all right? I mean, you got to challenge your disaster and you're going to end the program.

COL Simmons

OK. Yeah, like I know the the Jalen system didn't hurt anybody, but when it dragged, dragged the cable across the northeastern part of the United States, we we killed it because we didn't. We politically couldn't withstand that pressure. And So what you're saying, like the Louisiana? Manuel. Orders. That was one of the first large scale training events that the army did to prepare for World War 2 and taught us where taught. I think when I was reading about it, it taught us where units were ill trained and we where we can focus in our in the years prior to our entry into

World War 2. In Europe and which senior leaders had the skill and the ability to fight, you know, divisions and cores and which did not.

David Christensen

Right. And and here's this interesting thing about Marshall. Marshall loves the Louisiana game. COL Simmons

OK.

David Christensen

50 of his officers that participated in that made it to Geo, and we're all, you know, your patients, your bradleys it. I'm just kind of shaping how great Marshall was for us during that time period and he keeps us afloat without him. But something we skipped 193639. We're not paying attention. We don't do those maneuvers till 41 after we see what German May did to France and Poland. As in as quick as they did. We're missing another paradigm shift that we had in that time period and it.

Speaker

Oh.

David Christensen

I think one of the examples today that. That. That risk that I explained, that we're unwilling to accept, and our Marine brother could probably attest to that. I'm still amazed at the offspring. COL Simmons

Oh, I see. Yeah, the as far as what you're saying? The Osprey being one of the first. Vertical takeoff and landing vertical take off and and airplane flight transport that we have, but it's still even to this day, one of the more riskier platform air air platforms that we have. David Christensen

Right. We firmly believe it's an answer answer those physics are there, we just haven't conquered it and that. At the cost of human tragedy. Yeah, that's a factor. You gotta include your paper. OK, that, that, these things that we do, these these shifts, we try to make these quantum leaps, they do come at a cost financial cost. You know, ICS that network. Electric warfare E. Even in the 90s, you remember when they stood down a whole division 4th ID. You called it task force 21. COL Simmons

Oh yeah, for that was going to be the digital, the digital division. Yeah, yeah.

David Christensen

It was, it was. It became. But that was at the cost of careers meaning. First couple of years, it's a failure. And nobody wanted to command that division or be any. Way associated with that division. So the army did a shift, they started picking leadership. From MIT graduates Ricky Lynch. William Wallace, **** Cody Cohn and Perkins was no Cohen. Yeah, maybe Perkins, these guys were. All. The best, the best intellectually, and they had hard science stem degrees if you would. OK. So after years of failure, we put this team into fourth ID. And guess what? Eat players you know, going from singles eclairs, Blue Force tracker, all these things you see on the digitized battlefield today came out of that, but we couldn't get there till we put the right leadership, which was a whole different way of thinking for the United States Army. Because if you're not gratified.

COL Simmons

Yeah.

David Christensen

You're not certified to be an infantry officer. No, we needed highly intellectual guys that studied at these institutes like MIT, like who's the other one? Cal Poly to lead this division forward. Not

that we had to have those throughout the ranks, but to take that. The vision and make it successful, they needed that. Now it becomes commonplace. Everything looks like 4th ID on the battlefield, but not until they could figure that out. I hope I'm helping.

COL Simmons

OK, that's a no. That's a good. That's a good story. No, that is. Yeah. Cause I think we. The 4th idea example is a great example where we are kind of looking at ourselves where that only not only touches like the adaptive leader and the strategic vision, but also the culture of of leadership as that changes. And then as you're saying, when we changed how we selected. Leaders and the qualities of those leaders, we started seeing better success.

David Christensen

Yes. And the culture of embracing, that's when the military started taking officers again. BYOD did and start doing the training with industry program.

COL Simmons

OK.

David Christensen

So culturally, what we did is we took kids with undergrads, send them to grad school, and then it didn't hurt their career for them to go work with the Raytheon. The VA, the Lockheed, the Boeing, because they were working with industry that was looked as a nominative, so you didn't get a rating, but it was kind of like being a congressional or JCS today that. Those assignments catapulted you to the next rank. You weren't taking risk. You were bringing something back to the military.

COL Simmons

Yeah. OK. That, that, that sounds like for us, it sounds like kind of like the Quadro, the quad Helix idea of the interactions between government, private sector, academia and civil society as well as maybe a little bit of the innovation.

David Christensen

Yeah.

COL Simmons

Ecosystem and how how things are produced and and and enter into the the DoD.

LTC Gueller

I have just a follow up question on that. You said it didn't affect their career. Do you think now it does in a negative way? Often times when we don't go the traditional?

David Christensen

Right.

LTC Gueller

Route and the career paths.

David Christensen

It it can and, and here's what HRC's. Responsible for there's coatings that happen within jobs, and if you put that coating that this is a nominative position when the board meets. You know how you set forth the? Rules of the board. They know that, hey, this coating was a nominative. So even though you only get, you know, a a signature from a senator on how well you did like Aveda, if you would, instead of the traditional officer record report, these carried more weight. And I could give you a six plus as opposed to A5. Based off the fact you did a nominative and and most nominative, you're going to have an increased rating that not all jobs are created equal. You do a deputy whatever job and you get a. What we call an MQ. You know the highest rating possible. I might only be able to give you a 5 out of 6 plus, but if it's a nominative position that

frees up the point system that I keep. Yeah. So so it does. Weigh more if. That you do these type of systems. But only if they're code. As. Potentially nominative or nominative positions for the good of the military, you're in this you're doing this working with industry, you're doing this, whatever it is that we ask you to do because. You fit that type, you know, and the other fix we had to take with Army culture was the functional area I remember. When I was in, I had some other things that I did for the army well. To do those things, I had to go find a KD in my basic branch. And then I went back out and did what today would be a functional area, but I was always at risk because I had to go back and. KD. Today or in 2000, to fix that culture of these. Functional areas we needed System Administrator comptrollers strategists. We created functional area tracks. Where you didn't have to compete. Against your basic branch anymore. So. There's ways we fix these for the. It just takes unfortunately sacrifice. I I don't know how many people I watched lose their careers because they were Russian fails, right? And they couldn't get back to their basic branch to KD. Well, now they don't have to. Russian fails, you know, get a look within their functional area. So.

COL Simmons

Yeah, that's good. No, that that's that's helpful, Dave. Yeah, it's for for definitely kind of tracking our culture shifts. I was going to ask you, it seems like we've talked a good deal about some of the our our categories. What we'd we'd probably be interested in picking your brains on what you have to say about how strategic vision and something we're calling preparedness, how that plays in during the interwar period and now projecting in the future for guiding innovation or guiding guiding the military.

David Christensen

Unfortunately, the only success I've seen or read is when it's top driven rather than grassroots. What I mean by that? You got a lot of Jedi Knights out there in the military and you got a lot of great papers coming out of thinkers coming out of the war, college and CGSC and. Let's even go down the Captain Career course where, you know, Marshalls hanging out. You, you have them. But these grassroot programs? Me at SLAM ramp for their defense example, they never come into fruition. I I think I told you, Doug, a lot of times what bothers me is 80% of what we work on and do. Never comes to fruition. But when it's top driven, zoom, waltz, Navy, where he changed the whole culture of the Navy in the 70s. Shinseki. And. And then, Millie, remember Millie's comment. We need 7 new platforms, but without air defence, you're all dead. Speaker

Oh yes.

David Christensen

All of a sudden our portfolio goes to 14.8 and we just grew, what, 7 battalions in five years, who's doing that? But it was a top driven. Millie understood. Or his advisors, but he never gets some credit. Whoever the hell they are. You know where Dempsey? Always you always knew who was feeding Dempsey his stuff. Millie recognized that we needed to go back and stand up and see FT's. But that Modern Warfare, it was air defense, not so much the branch but anti cruise anti drone anti cyber that these I mean Cyber Center has a Lieutenant General in charge. You know what I mean that he took. That's that. Maria Barrett has six center and cyber center at Fort Gordon.

Speaker Sure. David Christensen Whatever it's called today, Eisenhower. That's one of the things that bothers me about growth or lack of growth is you don't see see Dids right combat developers. Creating things with industry and that becoming the next shift in the military. Or these. Kids we send to grad school that are sitting at MIT that come up with the solution set right now, we're stuck back in that it's a top driven Shinseki's Brigade Combat team. Thing is still alive in today, but that was a top driven chief of the Army initiative. I mean and you still weren't a break, you know. What I mean? COL Simmons

Yeah, yeah.

David Christensen

Yeah. So that that's the examples I've seen.

COL Simmons

Now that that's helpful, because I think we're we're finding examples. You know we we we've identified innovations you know U.S. military or the US and Japan were both innovative when it came to carrier aviation and saw its potential. Obviously German, with its mobile warfare and we have the we have the British with its integrated air defense and we have the the Russians with their deep battle concept and so but all those things seem to be a. You know from very senior officers. Showing elasticity of mind to to overcome capability gaps and so it is. I was I was going to ask you during interwar periods it is your expert opinion that top down strategic vision is better for innovation. Then bottom up bottom up. We're fine then, OK. David Christensen

Absolutely not. Absolutely not. Here's why. Every example that we talked about, even with the British, what the Russians are doing and all that those were captains and majors that fed it. That now look at their ages. They're 30 year old generals. They're not your 4050 year old generals, they're they're catapulted quickly at the offset of World War 2 because you're building a force and and what's sad. Yes, you did say the British. And the Russians and Germany. And we're not following it. We're not listening to major patent major. Yeah, he's a major at the time, Major Eisenhower. I'm going to give you an example of Eisenhower. He here. Here's another great mind. OK, we got this prodigy that we freaking love. Named MacArthur, right? That does nothing. Innovative. You got Eisenhower as a major now he's a Lieutenant Colonel. You know, in December 9th, 1941. He hands Marshall is Normandy invasion plan. And Marshall looks at him and Marshall had the wherewithal of the elastic thinker that he always was. He's chief of the army. He says, kid, you're gonna implement this and makes him a Major General overnight. Right now he's and then he becomes our Supreme Allied commander. Patent. Doesn't get the credit as a major patent is the one the Louisiana maneuvers is his as a major.

Ah, OK.

David Christensen

Yep, and. Bradley didn't do much. And then and then your Navy guys, you know like. You now you remember, these guys were ostracized. In the inner war period. 19/20/1939 time frame. The Oscar sized guys were your Nimitz, your halseys right? Because they were going against the north. They wanted a carrier centric Navy like the Japanese, but everybody that was the CEO of the Navy on Down, wanted a battleship centric. The battleship will win the next battle. But who ends up leading and look at their ages of how young these guys were during World War 2. You know, they weren't that old when they. Leading these carrier task force, I mean those, yeah, even your squadron commanders that were teaching tactics, you know, to squadrons. I mean, they've only been in the Navy for like 2 years, but they were so innovative. They were pilots, they

understood physics that we make the Navy make some squadron commanders, and they were able to outmaneuver the foe or come up with. Different aircraft that were more defensible and. More adaptable, which brings me to one more quick example and I know I ramble a lot but. The P51 Mustang you want to take a piece of equipment in a war period. We're watching what's happening in Germany, 193919401941. We still haven't been bombed yet. Right? Yeah. We're doing Lend Lease. Well, we came up. We saw the Spitfire in all its glory. And what it's trying to do in the defense of Britain and we come up with this thing.

COL Simmons

OK.

David Christensen

Of the lamb. And we designed this aircraft when we give it to the bridge and the bridge said, hey, exactly what we need, except that that fuel tanks was one of them longer range fuel tanks. So they could escort bombers. So we bring it back and now we're involved. Now it's December 7th and we're going to start going into Italy and North Africa. We take that experimental. Aircraft that we were selling to the bridge. Rename it the P51 Mustang and it becomes the workhorse to replace the P38 P 40 so there is. Unfortunately, times when we make these leaps. But it takes. Other nations expense that these proxy wars Ukraine allow us to experiment with things. From our foxhole World War One was the same way. You know, we were in theater for. A year, right? COL Simmons

Yeah, you were. You were saying that with the American Expeditionary Force, we were there for a year, but it was to acclimate, right? We we actually didn't get didn't get into an into a fight for for, you know, it took us a year to get into the fight. Once we landed in. David Christensen

But everything we learned from that year, we quickly developed. Our tanks we quickly developed. We're already sending materials to both belligerents, believe it or not. We're selling materials to the Germans too and the but we took all this innovation of that period and took it to the war front that we were outmaneuvering out fighting out shooting, you know, even our infill. Rifle. You know, we had their version and ours, which was better. The air defense for an example. It teaches the students it took 10,000 rounds for the French 6000 for the British because we were innovative and got to sit back for a year as anti shaves. Watching this it only took us 600 rounds, 1/10 of the munitions to take an aircraft out or pilot. In that matter. So our leaps, unfortunately are either stand something down. And make that an experimental division which is asking a lot or take the Ukraine. I don't know where else you would go right now. You know, other than all these other proxy things with Syria. Take. Take your young officers and have them come back. But what we don't do, we don't do anything with that information. COL Simmons

No, that's good. Yeah, that's good. That's good, Dave. Because we I think we we're we, we would definitely be interested in in kind of looking to the future as far as you know what you know when they when our decision maker asks us what were the conditions, factors and lessons.

David Christensen

Done.

COL Simmons

During the interwar period, how is that successful? I think it might be very helpful for us to highlight these examples. The P51 and the attache experiences and how that educated. David Christensen

Yes.

COL Simmons

And when we look into the, when we look into the future for like joint force design 10 to 15 years or I think it's 10 to 15 years in the future, you know how are we leveraging our international partners to to advance our own equipment. And how are we leveraging their battlefield experience to advance our own doctrine and concepts?

David Christensen And that's the link we're missing right now. That last piece that. No matter who's doing maneuvers, who's we never bring it into the school because we're doing the school solution and prepping you to sit somewhere in CENTCOM. You know, rather than really, really maneuver, shoot, move, communicate. Yeah. What we do in large scale operations, you know, and I

apologize. Here's what was hard for your problem.

Speaker

Yep.

David Christensen

When I brief history of armed forces, there's two Dark Ages, 1919 to 1939 is one of them. The other one was between civil war and Spanish American war. If we weren't fighting Spain, if we're fighting anybody with the darn, we lose. You know, the Spanish American war. All that did was pump our ego. But they were third class military at that time. They were overextended. So yeah, you picked a dark age.

COL Simmons

Well, I think that was for our decision maker. He was characterizing the this is an interwar period. Because we had just left Iraq and Afghanistan, and I think he saw some commonality between maybe the drawdown of the forces or the the lack of recruiting causing a draw. Down. And you've got this nation that is now a status quo nation seeking to preserve the global order, much like you had during the interwar period after World War One. And he's interested in how what those nations did to, you know, foster innovation.

David Christensen

Right.

COL Simmons

And what to avoid because you know we we don't know when the next conflict will arise, but we have we have examples in the history of what perhaps we should do to prepare ourselves for the next conflict.

David Christensen

OK. Yep.

COL Simmons

And and part of our part of one of my lessons is, you know during the Inter War period, nations that participated, I think in the Spanish Civil War, I like to say got a free Rep because they got to practice their doctrines. And their concepts on the battlefield and got to see what worked and what didn't. But that did. That did incur risk. People did die, but they were able to either validate their ideas and where is that for us when we look at the 21st century?

David Christensen

Right. It took us till 1941 to actually take what we saw and put it into practice. Once we saw Germany used it on Europe. We dismissed everything we saw in Spain. Now, so the Navy is making more innovations than the Army other than Marshall, you know. A successful inner war period for me. Was post Vietnam OK? Because we swore we'd never have another one. And you

know we. Tried to take. Just look at the elevation of the helicopter. You know, the Huey was a solid, but not a fighter. We tried to do the COBRA, but the COBRA was a death trap. Nobody wanted the cobra, so we took all those lessons and came up with the Apache and and the Huey. The armor tanks were. Tin can death traps. Yeah. And create an Abrams, you know. Thank God he's chairman. Joint staff said I want a tank. That is survivable. So that's why the M1 is what it is today and what we named it after, because the primary thing at the Abrams, no matter how well shot, move communicated with survivability of that crew.

COL Simmons

Ah.

David Christensen

Air defense was obsolete. Meaning you had ground forces fighting ground. We were fighting ground forces in Vietnam. You guys needed an air breathing. Peace because Nike and hurt was too cumbersome. So you come out, post Vietnam up to desert Storm. You know, we still have everything. We fought in desert Storm. Yeah. That was a successful in award period. COL Simmons

OK. One in which the United States. Or the United States military did a lot of introspection and and change versus the inner war period that we have between World War One and World War 2, where the nations of Britain, France and America did everything they could to avoid war. And and and, you know, shifted federal funding from their militaries to civil society. David Christensen

Yeah, and don't. Don't dismiss. You know the Dust Bowl and the Wall Street crash. Those two things made it that period that. OK. OK, you know what I mean? I mean, if you don't, yeah, everybody thinks FDR, you know, that will this new deal policies shaped it. But World War 2. Shaped everything we had going in, you know, 39 is when we did start paying attention and start bringing money into the military again.

COL Simmons

No, you're right. And then also in 39, that's why I was taking the note where we we start the I think it's called the National Research and. Development Council, which then was the which then gave birth to a subcommittee called the OSO SR0R 0SD R and that was the the the committee that helped really foster a lot of defense innovation and even the Manhattan Project. But it wasn't until 39 that the federal government took on a a much more hands on approach to research and development and creating a an innovation ecosystem.

David Christensen

Yep. Man, you're doing your reading.

COL Simmons

OK. No, that's that's helpful, Dave. I'll, let's see. Do we have anyone else have any other questions? This has been great. Yeah. Thank you, Dave. So I think, Dave, the last thing that we may not have covered directly, but you have helped us. We talked about innovation ecosystem and creating ideas, elasticity of mind for.

LTC Gueller

Yes.

COL Simmons

Military leaders to see the potential in things and strategic vision between top down and bottom up. Do you have any? I do you have any kind of analysis on what we call the Quadro Helix of connections and what we're describing is the process in which. Private industry, academia, the

government and civil society connect with each other to help form maybe the. Form ideas that the innovation ecosystem that helps then helps create. David Christensen OK so. I had a TS and I was SC. I read on. **COL Simmons** Right. Yeah, yeah. David Christensen And I spent some time in California, near Monterey and Vandenberg. A lot of things we took to the battlefield. During the onset of OIF that are commonplace now, even with people on their cell phones we had meaning. COL Simmons OK. David Christensen They were private. What's that word that I'm trying? Proprietary. **COL Simmons** Yeah. OK. David Christensen Alright, so let's say. Uday and Osay are out there talking on their cell phones. Today I could. Track my kids off my cell phone, but in 2000. 3-4 you couldn't do that. Yes, you could. Speaker Ah. David Christensen Is that the example you're looking for? **COL Simmons** Yeah, I I think that might be helpful. I'm writing down the note classification of information and technology as a barrier, as a barrier that prevents that. David Christensen Satellite phones, because I was on a Geo staff with Sullivan during Desert Storm. We had capabilities that the world didn't know we have or. But now everybody has. Yeah, we do work with them. It's at a classified level. You have to get read on. Certain units are provided those things or certain headquarters or talks and and then after seven years, you know then that. Whatever it is legality that Jack reads you on, you know those things start becoming funding themselves into the private sector. Speaker OK. David Christensen But innovation I I will tell you, if you ever wanted to see somebody that worked closely with the military and built with the military. That Batman quote, the saying what you want, but this is what you need. Howard Hughes. **COL Simmons** OK. David Christensen What Howard Hughes provided to the Army Air Corps. Is amazing how he did it, how he brought private sector, you know, cause he owned trans TWA Airlines too. He he took all his

innovation pitches. But he. Built these prototypes to introduce them to us because I don't know if
it was patriot or or money, but he's an example. Man, I can't get into some of these names. Henry Ford.

COL Simmons

OK. Yeah.

David Christensen

You know the and the Dodge brothers with the Jeep these vehicles. That they introduced to us. Out of I know they're making money, but yeah, we worked closer with industry. Now it's like industry. Here's what I hate to you want to write this one down? Stifling. Contract scope of work. Yeah.

COL Simmons

Contracts. Yeah. Contract the contracting process.

David Christensen

Right. That look, I want you to build me a new fire. I don't care what it is. A new widget. You agreed to build me this new widget. It within the scope of work. But now as we go through the developmental phase, we're finding out that it needs to exceed your scope of work. Howard Hughes would take on that. Mission and give you a product that was pure, true and ready to fight today. I don't. I know for a fact. They know what the end state is, but just to get. They do this scope of work get finance and and they provide you. An 80% solution, but then to get the scope of work F35 you gotta keep on paying and building and and they're always a day late. I know for a fact. I purposely I I was supposed to command a line unit right and I wanted to deviate and be a 53 and my boss said absolutely not. You're gonna command line unit but he let me go to the System Administrator course so that anytime I had a freaking contractor on the battlefield with me, I knew more about programming. Than he did. You know, and cascading effects and doing a patch on my system, whatever my system is I'm fighting. I think that stifles us those the way we contract and scope of work. We're not able to have that contractor produce and stay with us in the long run to come up with I VCs or the next generation, whatever it is, because we lose momentum based off of cost over cost and trying to get reappropriated. Fund that. Whatever it is, it is a stifling process.

COL Simmons

OK. Yeah, I think that. All right, then. Yeah. I was gonna say the part of that kind of the the interaction will also be we've read I was reading some of our literature about building trust with industry. And I think that goes two ways. We want a we want a dependable industry partner that can deliver something that's useful that doesn't soak us. With exorbitant amounts of money and industry wants to be able to be assured that year after year they can have a dependable stream of. LTC Gueller

Funding. It's really having a true a true partner versus like us leave. We pay you like let's really partner on this where we have equal interest.

David Christensen

Yes.

COL Simmons

A true partner rather than. Yeah. Right. OK. Yeah. Well, I can definitely see where Howard Hughes, Henry Ford, and the the Dodge Bros, as you were saying Jeep, you know, those were those are true partners for the for the, for the war department. And that that did that actually did produce some meaningful innovation.

David Christensen

You know, and it's funny because Eisenhower warned us to keep. That system, and he warned us against what would happen with. You know, the industrial complex was the term he used at the time that we did not keep two partners and and asked for end stake instead of yes. Yeah, yeah. Reed, Eisenhower's contacts. **COL Simmons** Yeah. I'm going to write that down. Yeah. David Christensen And I will tell you, these contractors got nervous and a. Lot of them. Fell out of the game because of the. Trials of the 1950s. COL Simmons Oh, is that the are you talking about? The the Communist, the the red, the the red scares or I got. David Christensen Yeah. **COL Simmons** You right. David Christensen Yep, it made it hard for you to want to work with the military, and you just have to read why that's a whole different. Basis if you would. COL Simmons OK. David Christensen Yeah. **COL Simmons** Military industrial complexes alright. Speaker OK. **COL** Simmons Then I'm going to turn over to the team to see if we have any other questions. But Dave, I think this has been a fantastic interview so far. So thank you any thanks. David Christensen I hope so. Thank you, Doug. COL Simmons No. OK. I. Hey, Dave, I I, I we kind of already had our questions lined up for you that.

Annex E Innovation Continuum



Annex F

Peterson's Analytic Confidence Worksheet

	Points Possible	Points
Use of Structured Method(s) In Analysis	(1-10)	-
For example: ACH, IPB, Social Networking, Bayes, Simulation, etc		
10 indicating highest possible score when considering factors below		0
Consider		
Number of		
Applicability of methods to the analysis		
Level of robustness of method		
Degree to which methods' results coincide		
Overall Source Reliability	(1-10)	
A rating of 10 indicates the highest reliability	1.101	-
A found of to managed the ingreat removing		
Source Corroboration/Agreement: Level of conflict amonast sources	(1-5)	
5 No confliction amonost sources		
4 Very little conflict amonast sources		
3 Moderate conflict amonast sources		
2 Significant conflict amongst sources		
1: Sources conflict an ready all points		
r, sources connet or nearly ar points	-	
Level of Expertise on Subject/Topic & Experience	(1-5)	-
5 Deep intimate knowledge and understanding & 3+ years experience with topic	1.4	-
4 Wide knowledge & 1.3 years expension with topic	1	-
3 Moderate knowledge & 6.12 months evidence with tonic		
2. Moundate knowledge & 0.5 months experience with longs		
2. No knowledge & co amoritance with the tenis	1	
T. No knowledge a no experience with the topic	-	-
Amount of Collaboration:	(1-5)	
5. Part of aggregated individual analyses		
4. Work on a team		-
3 Worked with a partner		
2 Casual discussion		
1 Completely individual work		1
Congretely exercise tern		
Task Complexity	(1-5)	
5. Minimally complex & challenging		
4 Somewhat complex & challenging		
3 Moderately complex & challenging		
2 Oute complex & challenging		
1. Very complex & high challenging		
Time Pressure: Time given to make analysis	(1-5)	
5. No deadline		
4: Easy to meet deadline		
3: Moderate deadline		
2 Demanding deadline	in the second se	
1 Grossly inadequate deadline		
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Annex G

Friedman Corollaries

Two questions a researcher should ask oneself in order to reassess bias and improve validity to an estimate.

- 1. Is my estimate within the range of reasonable opinion surround the question?
- 2. How likely is it that new information will change my estimate?

Source: Jeffrey A. Friedman

Annex H

Standard Primary Source Credibility Scale

Source reliability is noted at the end of each citation as low L, moderate M, or high H. The citation is hyperlinked to the source, unless the source is a paid subscription; in that instance a footnote is provided at the end of each writing illustrating the source for credibility. Source reliability is determined using the Trust Scale and Website Evaluation Worksheet found in Annex F

Importance	Factor	Description	Satisfies Criteria (Yes /No)
HIGH	Has a good track record	Source has consistently provided true and correct information in the past	
	Information can be corroborated with other sources	Information provided by the source corroborates with information from other primary and/or secondary sources	
	Information provided is plausible	High probability of the information being true based on the analyst's experience of the lopic/subject being investigated	
	Information is consistent and logically sound	Information provided is consistent when queried from different angles and is logically sound	
	Perceived expertise on the subject	Source is perceived to be an expert on the subject / topic being investigated and/or is in a role where subject knowledge is likely to be high	
	Proximity to the information	Source is close to the information – a direct participant or a witness to the event being investigated	
	Perceived trustworthiness	Source is perceived to be truthful and having integrity	
MEDIUM	No perceived bias or vested interest in the subject / topic being investigated or on the outcome of the research	Source has no perceived bias or vested interest in the subject / topic being investigated or on the outcome of the research	-
	Provides complete, specific and detailed information	Information provided is specific, detailed and not generic	
LOW	Is articulate, coherent and has a positive body language	Source is articulate, coherent, has a positive body language and does not display nervousness or body language that can be construed to be evocative of deceptive behavior	
	Recommended by another trusted / credible third party	Source is recommended by others the analyst trusts but the analyst herself does not have any direct experience working with the source	
	Sociable	Source comes across as outgoing and friendly. Easy to get along with and talk to	
	Perceived goodwill to the receiver	Perceived intent or desire to help the receiver or the analyst	

Annex I

Trust Scale and Web Site Evaluation Worksheet

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Annex J

Certainty 100%		
Almost Certain	86-99%	
Highly Likely	71-85%	0
Likely	56-70%	2
Chances a Little Better [or Less]	46-55%	÷
Unlikely	31-45%	0
Highly Unlikely	16-30%	≚
Remote	1-15%	V –