

DEPARTMENT OF DEFENSE
DEFENSE SCIENCE BOARD

21st Century
**Multi-Domain
Effects**

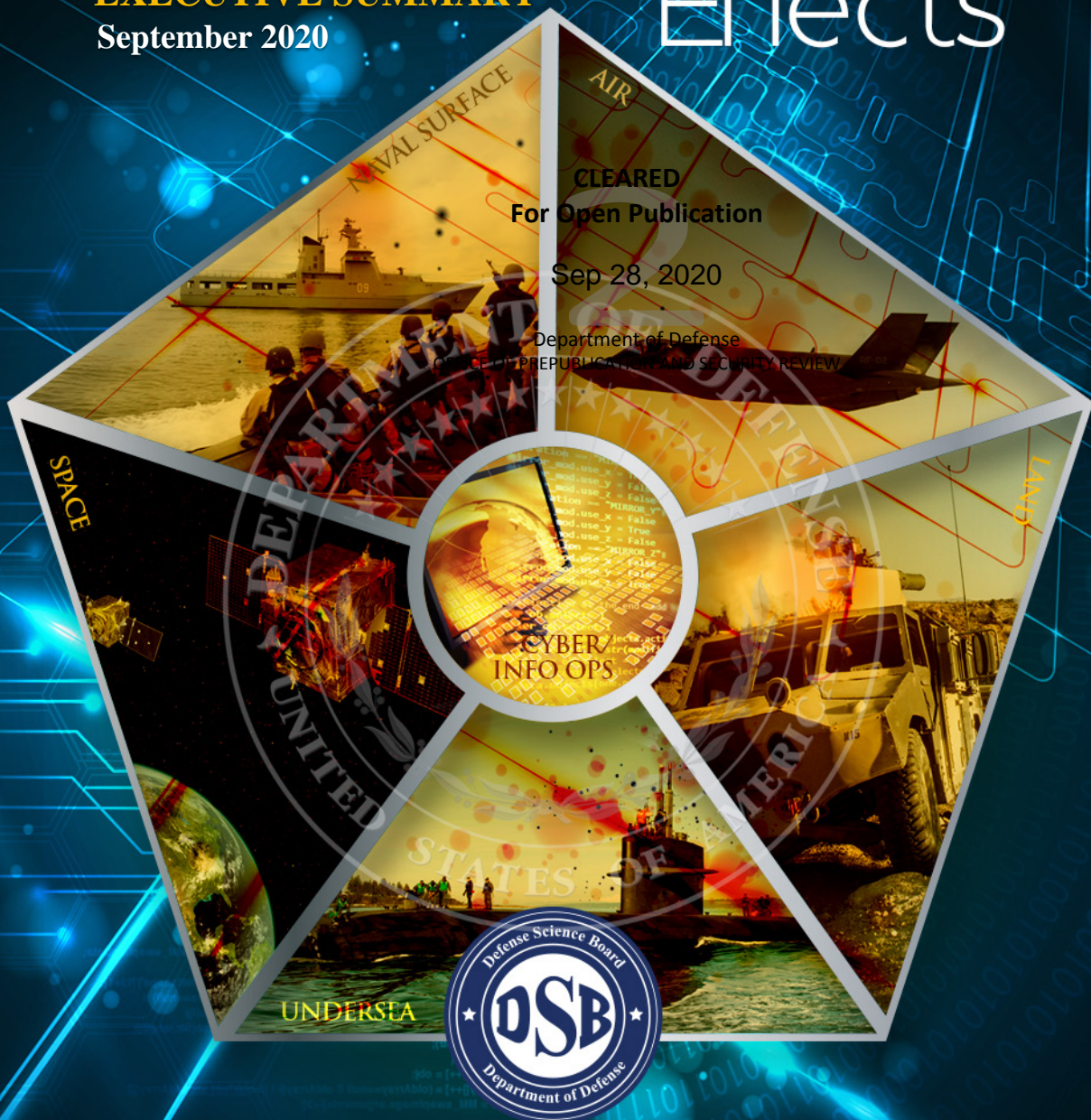
EXECUTIVE SUMMARY

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OFFICE OF THE UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING

This report is a product of the Defense Science Board (DSB). The DSB is a Federal Advisory Committee established to provide independent advice to the Secretary of Defense. Statements, opinions, conclusions, and recommendations in this report do not necessarily represent the official position of the Department of Defense.



DEFENSE SCIENCE
BOARD

OFFICE OF THE SECRETARY OF DEFENSE
3140 DEFENSE PENTAGON
WASHINGTON, DC 20301-3140

MEMORANDUM FOR: UNDER SECRETARY OF DEFENSE FOR RESEARCH AND
ENGINEERING

SUBJECT: Final Report of the Defense Science Board (DSB) Task Force on 21st Century
Multi-Domain Effects

I am pleased to forward the final report of the Defense Science Board Task Force on 21st Century Multi-Domain Effects. Current and future military power and effectiveness will increasingly depend on a nation's ability to conduct multi-domain operations (MDO). The integration of multiple platforms in multiple domains will allow for the execution of new defense capabilities. Nations that cannot conduct MDO risk being surprised on the battlefield, with potentially devastating consequences.

U.S. adversaries are working to ensure their militaries can conduct MDO, and the United States must do the same. This Task Force examined the DoD's ability to compete in a multi-domain environment and assessed options for improving U.S. multi-domain capabilities, technologies on the horizon and technologies ready for application. The Task Force found a number of areas where U.S. capabilities were inadequate to meet today's challenges. The recommendations of the Task Force propose actions that address today's issues while putting in place an architecture that can mature and evolve as conditions change.

Creating and sustaining a truly multi-domain force will not be easy. It will involve improving, modernizing, or restructuring processes in multiple areas, including command, control, and communications (C3), legal authorities, acquisition, and training. The Task Force identifies areas for improvement in these areas essential for generating multi-domain effects for current and future national security needs.

I endorse the findings and recommendations in this report and urge the Department to work towards their implementation. The process of ensuring that the United States can achieve its objectives in a multi-domain environment must begin now.

A handwritten signature in black ink, reading "Eric D. Evans", is positioned above the printed name.

Dr. Eric Evans
Chairman of the Defense Science Board

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DEFENSE SCIENCE
BOARD

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MEMORANDUM TO THE CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Final Report of the Defense Science Board (DSB) Task Force on 21st Century Multi-Domain Effects

Attached is the final report of the Defense Science Board Task Force on 21st Century Multi-Domain Effects. The Task Force was asked to examine the “range of doctrine, policy, authority, strategy, operational capability, tactics, implementation, and support options” required to respond to modern U.S. national security threats. The Task Force was then asked to provide a full range of options for the employment of 21st century multi-domain effects. Specific areas of focus in the report include:

- developing integrated multi-domain command, control, and communications (C3);
- developing policy and authorities to enable timely multi-domain operations (MDO);
- capitalizing on traditional and new opportunities for indications and warnings (I&W);
- breaking down stovepipes around the development of multi-domain capabilities;
- streamlining the acquisition lifecycle.

Throughout the course of the study, the Task Force examined Department efforts to enable MDO. Although there were no clear solutions in development at the time, there were efforts underway to solve critical challenges such as the Air Force multi-domain command and control architecture efforts and the development of new operational capabilities. Since the conclusion of the study, many of these efforts have continued to develop into concepts such as Joint All Domain Command and Control (JADC2), but there is still critical work to be done if the United States is going to continue to keep pace with our strategic competitors.

Throughout the War on Terror, U.S., forces have gained valuable warfighting experience. However, conflict with a more sophisticated actor and the emergence of multi-domain operations will require our forces to be faster, less detectable, and more integrated. The Task Force has provided eight recommendations that, if implemented, will effectively aid the DoD and the wider U.S. government in creating a more proactive and lethal force for the future of conflict.

Mr. David Van Buren

General (Ret) Philip Breedlove

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DSB Report on 21st Century Multi-Domain Effects

Table of Contents

Summary of Findings	1
<i>Multi-Domain C3 Status</i>	<i>1</i>
<i>Policies, Processes, and Authorities</i>	<i>1</i>
<i>Indications & Warnings (I&W)/Information, Surveillance, and Reconnaissance (ISR)</i>	<i>1</i>
<i>Operational Capabilities</i>	<i>2</i>
<i>Implementation</i>	<i>2</i>
<i>Whole-of-Government/Nation.....</i>	<i>2</i>
Summary of Recommendations	2
<i>Recommendation 1: MD C3 – Resilient C3 Architecture</i>	<i>2</i>
<i>Recommendation 2: MD C3 – Readiness Levels for C3</i>	<i>3</i>
<i>Recommendation 3: PD&A – Preplanned, Delegated Authorities and ROE</i>	<i>3</i>
<i>Recommendation 4: PD&A – Training and Exercises</i>	<i>3</i>
<i>Recommendation 5: I&W/ISR – Fusion Cell C3 Centers</i>	<i>3</i>
<i>Recommendation 6:</i>	<i>3</i>
<i>Recommendation 7: Operational Capabilities – Rapid Information Integration</i>	<i>3</i>
<i>Recommendation 8: Operational Capabilities – Multi-Modal ISR, Targeting, and C3 Architecture ..</i>	<i>3</i>
<i>Recommendation 9: Open Architecture Acquisition Strategies</i>	<i>3</i>
<i>Recommendation 10: Implementation – To Improve the Requirements Development Process for Multi-Domain Operations</i>	<i>4</i>
<i>Recommendation 11: Implementation – “De-linearize” Acquisition Process</i>	<i>4</i>
<i>Recommendation 12: Modeling and Simulation (M&S) for Acquisition Streamlining</i>	<i>4</i>
Appendix A: Task Force Terms of Reference	A-1
Appendix B: Task Force Membership	B-1
Appendix C: Acronyms and Abbreviated Terms	C-1

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DSB Report on 21st Century Multi-Domain Effects

Executive Summary

Future conflicts will be multi-domain in nature. It is essential that the United States ensure it has the ability to conduct multi-domain operations to deter and defeat threats against strategic competitors, some of whom have already demonstrated their ability to conduct such operations. The Defense Science Board's Task Force on 21st Century Multi-Domain Effects found that the DoD needs to better prepare to operate in a multi-domain environment, focusing on our ability to project power, deter adversaries, and assure allies.

Summary of Findings

The task force identified seven main takeaways from the study. First, the Joint Staff must ensure the command, control, and communications (C3) infrastructure is best prepared for multi-domain operations and takes into account protection from emerging threats. Second, authorities need to be in place before the beginning of hostilities to allow for a timely response to adversary actions. Third, gray zone conflict requires much speedier indications and warnings. Fourth, an open architecture is needed to enable quick and seamless communication across the DoD. Fifth, stovepiped weapon systems inhibit the interoperability necessary to conduct multi-domain operations (MDO). Sixth, the current acquisition life cycle is incompatible with the needs of MDO. Lastly, a whole-of-government approach is needed, with top-level attention, to prepare the United States for multi-domain warfare.

Multi-Domain C3 Status

During the Cold War, the United States maintained a global, centrally coordinated C3 system for its military forces. After the Cold War ended, this C3 system has not often benefited from new technologies that enable faster, better networked, and more secure C3. After the *Goldwater-Nichols Act of 1986* reorganized the U.S. military in its biggest restructuring since the end of WWII, C3 became distributed and focused on the regional combatant commands.

Emerging domains of increasing importance—namely space, cyber, and missile defense—have developed C3 structures of their own.

Policies, Processes, and Authorities

Current policies are not well designed to easily facilitate multi-domain attack operations. Decisions processes must keep pace with events on the battlefield. Authorities need to be given to ensure rapid implementation to succeed, to include cyber and artificial intelligence (AI).

Indications & Warnings (I&W)/Information, Surveillance, and Reconnaissance (ISR)

ISR is essential for conducting military operations against strategic competitors, and its importance has grown as combat has become more complex and distributed across additional domains. ISR capabilities provide order of battle information about adversary militaries and the technical characteristics of their military systems. They provide information about adversary intentions and tactics, techniques, and

procedures (TTPs) for conducting military operations. ISR also enables I&W that provide U.S. political and military leaders with alerts about possible or imminent enemy attack and associated risk assessments. Lastly, ISR provides Identification Friend or Foe (IFF) and Battle Damage Assessment (BDA) for U.S. forces—critical capabilities for gray zone and multi-domain environments.

Operational Capabilities

This is discussed in detail in the classified report.

Implementation

Implementing the ability to generate multi-domain effects to achieve military and political objectives will require truly open and rapid cross-domain architectures. DoD currently has multiple open architecture programs underway. The task force recommends a single, open architecture to best enable MDO.

Modeling and simulation techniques have matured substantially over recent years and should be utilized more heavily to reduce the concept-to-delivery cycle. The more that modeling and simulation techniques can be used for concept development, design, source selection, test, and modification, the faster the warfighter will receive minimal viable products (MVP) to provide feedback, and the faster that feedback can be incorporated into the system.

Whole-of-Government/Nation

Adversaries are becoming more proficient at advancing their military and political objectives without confronting the United States on its own terms with conventional means. All instruments of national power—military, economic, cultural, etc.—will be important for states to advance their goals, and states that can harness multiple instruments of power and integrate them in creative and reinforcing ways will prevail over those that don't. Cross-domain coercion and multi-domain effects will be critical for defending U.S. interests against strategic competitors. Enabling these capabilities in the service of strategic objectives will require a whole-of-government/nation approach, where different instruments of power are coordinated and mutually reinforcing.

Multi-domain operations are the future of warfare, and the future is happening now. The task force makes recommendations to further our MDO capabilities and on how DoD multi-domain operations fit into a larger national strategy for great power competition.

Summary of Recommendations

Recommendation 1: MD C3 – Resilient C3 Architecture

SecDef and CJCS (J2/3/6/JROC) urgently evolve and expand the current foundational C3 architecture into a robust, multi-domain warning and assessment C3 architecture best able to detect and respond to a coordinated multi-domain attack.

Recommendation 2: MD C3 – Readiness Levels for C3

SecDef and CJCS (J2/3) adapt the defense readiness condition (DEFCON) concept for conventional forces and key infrastructure to establish pre-coordinated readiness levels and a decision-making process that provides global integration while signaling U.S. resolve and maximizing responsiveness.

Recommendation 3: PD&A – Preplanned, Delegated Authorities and ROE

SecDef and CJCS establish a preplanned, tiered set of delegated authorities and rules of engagement (ROE) that ensure Combatant Commanders can adequately deter and respond to adversary multi-domain attacks in times of increased global tensions.

Recommendation 4: PD&A – Training and Exercises

Deputy SecDef (DepSecDef) and Vice CJCS (VCJCS) oversee restructuring of MDO planning and execution authorities and direct increased emphasis on comprehensive MDO training.

Recommendation 5: I&W/ISR – Fusion Cell C3 Centers

Director Joint Staff J28 (Battlespace Awareness) expand I&W/ISR data sources and processing at national, regional, and tactical C3 centers.

Recommendation 6: Cyber security should be a top priority for all commercial and military systems.

Recommendation 7: Operational Capabilities – Rapid Information Integration

USD(R&E) and the Military Departments rapid fielding offices, accelerate multi-domain activities yielding uniquely effective military capabilities with special emphasis on rapid information integration/data fusion feeding I&W and target prosecution at long ranges.

Recommendation 8: Operational Capabilities – Multi-Modal ISR, Targeting, and C3 Architecture

SecDef/CJCS task Military Departments “Vice Chiefs” accelerate needed MDO capability development.

Recommendation 9: Open Architecture Acquisition Strategies

USD(A&S) with USD(R&E) mandate consistent Open Mission Systems (OMS) and Universal Command and Control Interface (UCI) standards for acquisition programs.

Recommendation 10: Implementation – To Improve the Requirements Development Process for Multi-Domain Operations

USD(A&S) with USD(R&E) seek ways to improve the requirements development process specifically for MDO. Joint Staff should lead the implementation.

Recommendation 11: Implementation – “De-linearize” Acquisition Process

USD(R&E) with USD(A&S) should expedite R&D implementation e.g., expanding Other Transaction Authority (OTA).

Recommendation 12: Modeling and Simulation (M&S) for Acquisition Streamlining

USD(R&E) and USD(A&S) adjust requirements and acquisition process and task Military Departments to increase acquisition through reuse of software, use M&S for multiple purposes, use demonstrations to initially connect air and space domains with future adoption to all domains.

Appendix A: Task Force Terms of Reference



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JAN 27 2017

MEMORANDUM FOR CHAIRMAN, DEFENSE SCIENCE BOARD

SUBJECT: Terms of Reference – Defense Science Board Task Force on 21st Century
Multi-Domain Effects

The evolving threats to United States national security from China, Russia, North Korea, Iran, and non-state terrorists have vastly increased the complexity of U.S. responses. The array of potential responses, whether kinetic, electronic warfare, cyber, or other means, must be assessed along with measures to deter attacks and control escalation. These modalities must also take into account the level of response, the reversibility of actions, and the potential to escalate or de-escalate hostilities.

This Task Force is established to examine the range of doctrine, policy, authority, strategy, operational capability, tactics, implementation, and support options required to respond to threats to U.S. national security and give the Department a full range of options for the employment of 21st century multi-domain effects.

The study will encompass undersea, naval surface, land warfare, and air and space domains. The task force will not address the use of nuclear weapons.

A number of challenges affect the ability of the Department of Defense (DoD) to successfully implement a multi-domain response. To begin, doctrine, policy, and authority are key elements that underpin implementation of a multi-domain strategy and today are inadequate to support a fully integrated response. Further, acquisition strategies that are needed to deploy a multi-domain strategy are often negatively impacted by long cycle times and the cost of platform integration. Re-engineered support, training, simulation, and exercising are also essential. Logistical support is often the largest contributor to lifecycle cost, and well-designed exercises will drive the essential tactics, techniques, and procedures. All of these will have a significant cost impact on implementation.

Specific questions for the Task Force to address include:

- What is the promise – and what are the critical considerations – for use of 21st century multi-domain effects?
- What are the doctrine, policy, and authority implications? What specific recommendations would ensure rapid adoption of multi-domain courses of action? What considerations will enable the full range of options and the needed proportional and flexible nature of the response?

- What are the strategic and operational employment characteristics needed, considering existing near-term (2 to 4 years) and future (5 to 10 years) capabilities, that can and should be employed? What strategies are needed for “left-of-action” preparation of the battlefield?
- What acquisition strategies will be needed to implement these objectives, considering modularity, open architectures, data rights, and other stressing conditions? What levels of developmental and operations test and evaluation are needed?

I will sponsor the study, and Mr. David Van Buren and General Philip Breedlove (U.S. Air Force, retired) will serve as co-chairmen. Captain John Lemmon, U.S. Navy, will serve as Executive Secretary for the study, and Captain Jeff Nowak, U.S. Navy, will serve as the Defense Science Board Secretariat Representative.

The task force members are granted access to those DoD officials and data necessary for the appropriate conduct of their study. The Under Secretary of Defense for Acquisition, Technology, and Logistics will serve as the DoD lead for the matter under consideration and will coordinate decision-making as appropriate with other stakeholders identified by the study’s findings and recommendations. The nominal start date of the study period will be within 3 months of signing this Terms of Reference, and the study period will be between 9 and 12 months. The final report will be completed within six months from the end of the study period. Extensions for unforeseen circumstances will be handled accordingly.

The study will operate in accordance with the provisions of Public Law 92-463, the “Federal Advisory Committee Act,” and DoD Instruction 5105.04, the “Department of Defense Federal Advisory Committee Management Program.” It is not anticipated that this study will need to go into any “particular matters” within the meaning of title 18, United States Code, section 208, nor will it cause any member to be placed in the position of action as a procurement official.



James A. MacStravic
Performing the Duties of the
Under Secretary of Defense
for Acquisition, Technology,
and Logistics

Appendix B: Task Force Membership

Chairs

General Philip Breedlove, USAF (Ret.)
Mr. David Van Buren

Members

Lt. Gen Buck Buchanan (Ret.) Private Consultant	Mr. James Carlini <i>Private Consultant</i>
Mr. Andy Coon <i>Systems & Technology Research (STR), Inc.</i>	Dr. Lisa Costa <i>Private Consultant</i>
Dr. Thomas Ehrhard <i>Long Term Strategy Group</i>	Mr. Zachary Lemnios <i>IBM</i>
VADM Mark Skinner (Ret.) <i>Northrup Grumman</i>	Dr. Grant Stokes <i>MIT Lincoln Laboratories</i>
Dr. David Whelan <i>University of California</i>	Dr. Dean Wilkening <i>John Hopkins Applied Physics Laboratory</i>

Government Advisors

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Director, U.S. Air Force, Rapid Capabilities Office

Mr. Charles Nava
U.S. Air Force, Rapid Capabilities Office

Executive Secretary

Captain David Bauer, USN
Captain John Lemmon, USN
CAPT John Lowery, USN

DSB Secretariat Representative

Captain Jeff Nowak, USN Mr. David Moreau

Defense Science Board Secretariat

Mr. Kevin Doxey
Executive Director

Appendix C: Acronyms and Abbreviated Terms

AI	artificial intelligence
BDA	Battle Damage Assessment
C3	command, control, and communications
CJCS	Chairman of the Joint Chiefs of Staff
DepSecDef	Deputy Secretary of Defense
DEFCON	defense readiness condition
IFF	Identification Friend or Foe
I&W	indications and warnings
ISR	information, surveillance, and reconnaissance
M&S	modeling and simulation
MDO	multi-domain operations
MVP	minimal viable products
OMS	Open Mission Systems
OTA	Other Transaction Authority
SecDef	Secretary of Defense
TTP	tactics, techniques, and procedures
UCI	Universal Command and Control Interface
USD(A&S)	Under Secretary of Defense for Acquisition and Sustainment
USD(R&E)	Under Secretary of Defense for Research and Engineering
VCJCS	Vice Chairman, Joint Chiefs of Staff